

DOCUMENT RESUME

ED 192 067

CE 026 550

AUTHOR Huerta, John L., Jr.: And Others
 TITLE Vocational Academy. An Alternative Vocational Training Model, May 1, 1980, to September 30, 1980. A Research Monograph.
 INSTITUTION Nova Univ., Fort Lauderdale, Fla. Behavioral Sciences Center.
 SPONS AGENCY Florida State Dept. of Labor and Employment Security, Tallahassee.
 PUB DATE 30 Sep 80
 CONTRACT 80ET-94-11-16-05-014
 NOTE 167p.: Some pages may not reproduce well due to light and broken type.

EDRS PRICE MF01/PC07 Plus Postage.
 DESCRIPTORS *Adult Vocational Education; Allied Health Occupations Education; Career Ladders; Competency Based Education; *Economically Disadvantaged; *Educational Innovation; Educational Research; Electronics; *Employment Programs; *Federal Programs; Health Occupations; Instructional Innovation; Job Skills; Minority Groups; Models; *Nontraditional Education; Performance Tests; Remedial Instruction; Skill Development; Teaching Methods; Testing

IDENTIFIERS Comprehensive Employment and Training Act; Vocational Academy Project

ABSTRACT

This document contains four research papers of the Vocational Academy (VA) Project which researched alternative forms of vocational education to impact on CETA (Comprehensive Employment and Training Act) eligible participants. (The innovative approach developed incorporated a career ladder concept in skills training.) Preceding them are a discussion of the project, flow chart of the model program developed, and two synthesizing analyses of abstracts. Section 1 is entitled An Alternative Method of Training for Health Career Occupations: The VA Approach. It contains a literature review, field visit report, and recommendations for VA (sample career ladders and competency-based curriculum. Section 2 is the report, The VA Approach to the Electronics Industry in Broward County. It overviews electronics, reports on field visits, makes recommendations, and discusses curriculum, career ladders, and teaching approach. Appendixes include a sample career ladder, preliminary curriculum, glossary, and manual for incoming students. Section 3 is the report, Academic Remediation for Electronics Training: A VA Perspective. It contains a literature review, field visit report, and recommendations for VA. Section 4, Performance Assessment of Electronics Trainees, briefly examines two kinds of testing most relevant to the target population--(1) teacher constructed paper and pencil tests and (2) judging procedures, products, and performance. (YLB)

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VOCATIONAL ACADEMY

An Alternative Vocational Training Model

A Research Monograph

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Dr. Abraham S. Fischler - President, Nova University

Dr. John M. Flynn - Director, Center for Behavioral Sciences

Funding

State of Florida
Department of Labor and Employment Security
Title II, Section 202, Comprehensive and
Training Act, Educational Linkage
Contract #80ET-94-11-16-05-014

Duration - May 1, 1980 to September 30, 1980

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Purpose

To research current vocational education programs on behalf of CETA eligible participants, and to design an alternative training model.

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Note: The guidelines for manuscripts and references of the American Psychological Association were used in the writing of this Monograph (APA Publication Manual, second edition, 1980).

*References and Appendixes appear after each section.

VOCATIONAL ACADEMY

The Vocational Academy was funded (Contract #80ET-94-11-16-05-014) under Title II, Educational Linkages, of the Comprehensive Employment & Training Act with the State of Florida. The total amount of the contract was \$66,117.00 for the period February 1, 1980 to September 30, 1980. Although originally submitted as a 12 month grant, due to certain constraints pressed upon the State, the research actually began on May 1, 1980.

The purpose of the Vocational Academy Project was to research "alternative forms of vocational education to impact on CETA eligible participants." As defined in the 12 month grant, the research was to have been done on the design of a teaching model, with the ultimate establishment of an operational model. The operational model was to have offered the opportunity of testing the researched design against actual operating conditions.

Since the actual implementation of the Program did not begin until May, it was necessary to realign the previous goals to conform to the new time-tables. Given that the program was guaranteed funding only through September 30, with the consent of the State, the new adjusted goals offered were the following:

- 1) Performance of research in vocational education.
- 2) Development of an alternative design.
- 3) Literature review
- 4) Development of a paper explaining the design for possible replication.

It is under these goals that the Vocational Academy staff began a review of the problem to be addressed.

Definition of the Problem

The purpose of researching an alternative form of vocational education is to impact on certain programs contained in the operational system. The Vocational Academy staff identified two problems which were considered significant:

- 1) The drop-out rate at the remedial education level.
- 2) Preparation of participants at entry level only (learning ladder).

Remediation - Drop Outs

A review of the participant characteristics of the local Prime Sponsor (the Broward Employment & Training Administration) showed almost a 40% drop-out rate in the Adult Basic Education (ABE) and General Equivalency Diploma (GED) courses. Almost four out of every 10 participants under Title IIB of the Comprehensive Employment and Training Act (CETA), who were sent to pre-skills training remediation classes, did not complete the course. Also significant was the apparent rejection of structured remediation by Black males. Twenty percent (20%) of the participants who began remediation were Black males and none finished.

Although some of the participants who dropped out went to direct employment, the Academy staff speculates that these participants generally took lower paying jobs than positions that could have been available to them upon completion of skills training. Unfortunately, time did not permit staff to pursue statistical confirmation on this point. Staff speculation, however, was independently verified through interviews with key members of the BETA staff.

Training for Entry Level Only

Philosophically, manpower programs have set their goals at providing training for the economically disadvantaged to prepare them to achieve entry level placement. Beyond that, generally it is considered to be up to the individual to progress beyond that point. This accepted practice made it possible for the operator (Prime Sponsor) to distribute training funds among greater numbers of people, thereby having a greater impact.

As a result of this approach, many individuals find themselves in "dead-end" jobs, with little opportunity for advancement if desired. Another part of the problem is that many private industrial firms allow for upward mobility; however, for some trainees, the difference in the required knowledge between positions is too great to be learned without some kind of formal training. This also leaves the individual participant in a "dead-end" job.

Literature Review

After having defined problems to which we hoped to find solutions, the Vocational Academy staff began searching for information on how projects in other locations have dealt with the same or similar problems. A computer search was performed reaching into four major data bases and reviewing over 98 documents. Such data bases as the Educational Resources

Information Center (ERIC), the National Resources Information Service (NTIS) and the Government Printing Office (GPO), provided 241 abstracts which were synthesized by the Senior Researcher.

Also included in the literature reviewed by the Research Assistants under the direction of the Senior Researcher were journals for vocational education, special education and psychology. A complete listing is available in the bibliography and appendices. This literature also provided data on orientation to the world-of work and performance assessment.

Determining the Model

After a review of the literature, the staff in the weekly scheduled seminars discussed different ideas and methods that should be included in the proposed model.

In deciding about a method of attacking the problem of drop-outs, several approaches were discussed; however, one seemed most appropriate: concurrent skills training/remediation. As previously mentioned, vocational and technical institutions generally offer a pre-skills training remediation course to build reading, writing and math skills. This form of remediation is given before a participant is allowed to proceed into his/her chosen training class. At this particular step in the training process, there appears to be a significant drop-out rate.

Remediation is offered simultaneously with skills training in a system known as Individualized Manpower Training System (IMTS). The two keys to this system are: 1) The student divides his/her day with three hours of training and three hours of remediation; 2) The teaching process is based upon the ability of the participant.

The proposed concurrent remediation program would offer remediation in the same classroom that the participant is receiving skills training. The basic skills material to be used for remediation are the same as those used by the trainee in the skills training course.

Assuming that the courses established are competency based and allow the individual to progress at his/her own speed, this remediation directly will be relevant to his/her training. We anticipated that this individualized form of remediation will extend the amount of time necessary to complete the course; however, at the same time, it should also decrease drop-outs at that level.

The other major problem to be researched was the curriculum and training program for entry level jobs. A model was then designed to allow for a multiple-step system which provides for training at higher than entry level skills, as well as an exit opportunity for placement at the end of the entry

level. Figure 1 shows a participant flow in such a system. Given that the study package has three levels to achieve, there are three points at which a decision can be made either to continue with the training ladder or exit for placement.

Occupational Exploration

Although not specifically required by the Contract, the Vocational Academy staff thought it would be helpful to select research and define specific occupations to be taught within our model. It was never our intent to become enmeshed in writing curriculum; however, the model is of more value when one can show by example how it can be implemented.

At the outset, we looked at labor market data to try and determine which growth occupations in Broward County have high demand skills (a prerequisite in CETA). Our information led us to the allied health fields, electronics manufacturing and business.

The Vocational Academy Research Assistants first explored the literature in the allied health field. Research was performed in direct client services and laboratory services occupations. Career and learning ladders were set up to determine progression within the cluster of occupations.

Among the conclusions made in exploring the health field was the improbable entry of our population into the occupations researched. Factors such as rigid licensing requirements, high entry level expectations and academic rigors contributed to the recommendation of not proceeding any further into the health occupations. In the interest of good research closure, however, a career ladder was established and a vocational training hierarchy recommended.

The second occupational cluster explored was in the field of electronics. Labor market data indicates that electronics manufacturing is a high growth occupation in Broward County and South Florida. After the Research Assistants performed a considerable literature review, it was determined that the electronics industry provides satisfactory entry level positions and the opportunity for career growth without extensive academic or technical training.

Beginning with the electro-mechanical assembler, the Vocational Academy compiled a suggested curriculum with extensive input from the electronics industry. Field trips were made by the staff and current public and private programs were observed and curricula reviewed. Direct input was solicited from private industry through a mailing of our proposed curriculum outline, requesting reactions and revisions where

applicable.

Concurrent to the seeking of input from the manufacturing firms, the opportunity became available to seek funding to operate a test model of the Vocational Academy research. The Broward Employment and Training Administration (BETA) offered a Request for Proposals (RFP) to provide "innovative training" in the electronics area. At the weekly seminar of the staff, it was decided that, considering the time constraints and the depth of the research necessary to construct a complete enough model for implementation, the business topic of our research plan would be dropped.

In the opinion of the senior staff, it was more important to have a complete model in one occupational area than a cursory "touch" on several occupations. Based upon this rationale, the focus of the Vocational Academy became electronics.

Establishing Linkages

At the same time that the Research Assistants were gathering data, the Director and the Senior Researcher were establishing contacts with the local public educational and training institutions. The Senior Researcher made contact with Broward Community College, while the Director sought information from the School Board of Broward County and the BETA staff.

A critical part of the model developed was the involvement of private industry. Representatives of the electronics industry, including personnel and production managers, were interviewed and, as mentioned earlier, polled for input in the electronics curriculum.

Weekly seminars were held to facilitate the staff's transition into the select field. Closed working sessions were the norm; however, speakers were often invited from the electronics industry, the Broward School Board, and a retired electrical engineer attended a staff seminar as a consultant. These speakers were able to give continuity to the research and to offer a direct source of verification to the Research Assistants for independently obtained data.

As a result of the opportunity for local funding to operate a model program, firm linkages were established between the School Board, Broward Employment and Training Administration (BETA), Nova University and the Urban League of Broward County. The Vocational Academy and the School Board combined efforts in the submission of a proposal to BETA. The Urban League of Broward County was suggested as a community-based organization capable of promoting and operating the orientation to the world-of-work component of the model. This suggestion was based upon the recommendation of the Academy that the orientation specialist

(presenter) be of the same ethnic background as the majority of the participants in order to provide a role model. Since, according to BETA eligibility characteristics, the majority of the participants would be disadvantaged minorities, the Urban League was solicited and accepted the task.

Final Product

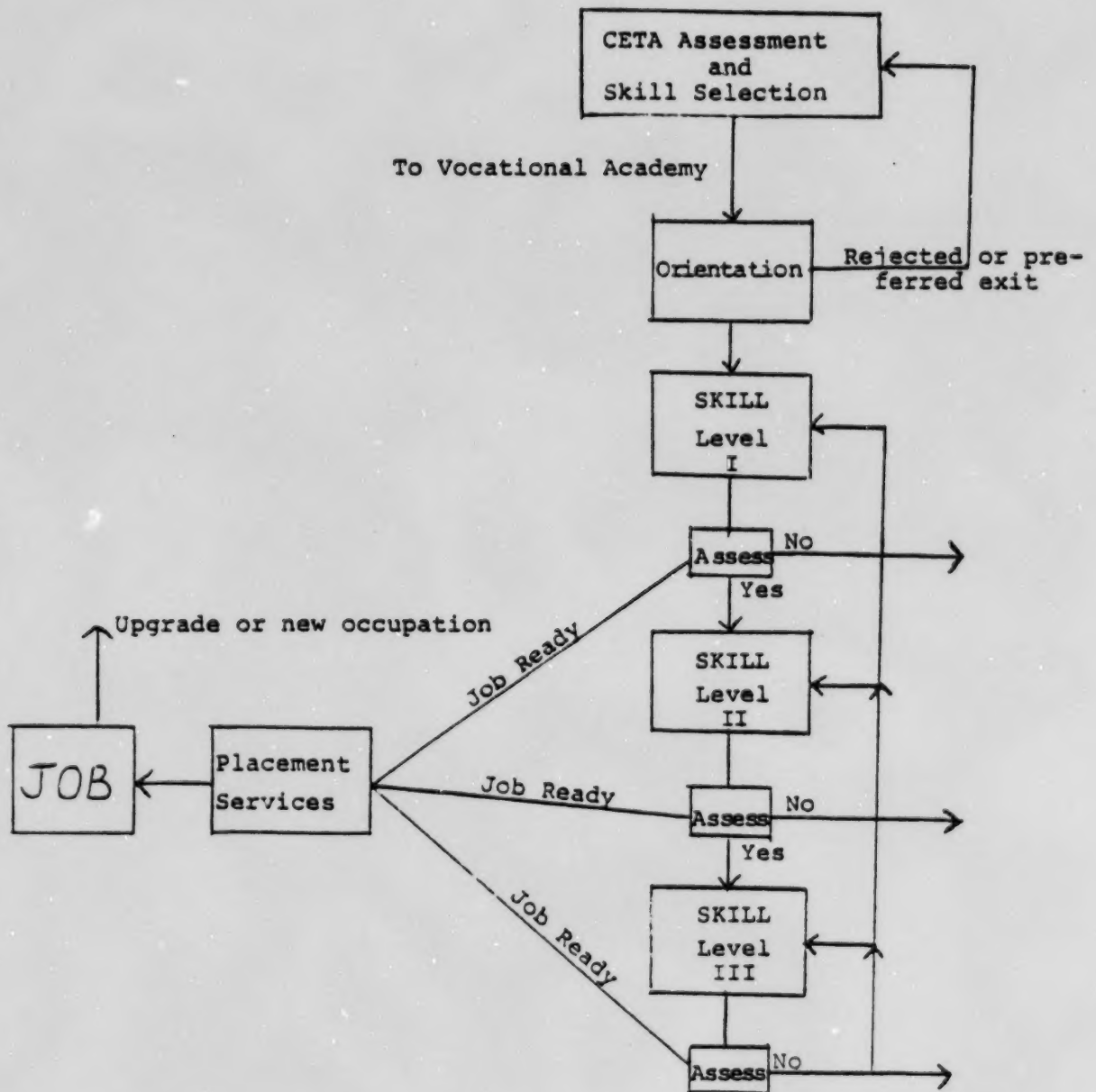
The papers which follow are the combined research of the Vocational Academy and include the recommendation for a model program. Since the Academy is a division of the Center for Behavioral Sciences, these papers follow the American Psychological Association (APA) format. Included are studies of the health fields, electronics, remediation, orientation to the world-of-work and performance assessment.

VOCATIONAL ACADEMY MODEL

FLOW CHART

Revised 5/16/80

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REPORT I
THE VOCATIONAL ACADEMY
SUMMARY REPORT

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Synthesizing Analyses of Abstracts

June 2, 1980

Hilda O. Fortune, Ed.D.
Senior Research Planner

During the month of May, Pat Kelley and Helene Walczak, Research Assistants, read and evaluated the 21 pages of abstracts from ERIC (Set I) which had been requisitioned in advance by John L. Huerta, Jr., the Director. The abstracts were received from Lockheed Information Systems, Code 52-08, Bldg. 201, 3251 Hanover Street, Palo Alto, California 94304. Some pages had several abstracts, making a total of 46 read and analyzed.

Directions given the Research Assistants were to record identifying data, analyze abstract contents and evaluate each project or program in relation to its relevancy to the thrust of the Vocational Academy, which is stated by the Director: "The focus of the research is to examine and develop innovative vocational education programs designed to prepare individuals to meet their employment needs as well as the job market demands of private industry. The Vocational Academy was funded to provide an operative model for an alternative vocational education system with appropriate linkages between private industry, CETA Prime Sponsor and educational institutions."

The Abstract Analysis form, prepared by the Senior Research Planner (See attached) was refined with the assistance of the Director and the Research Assistants. After testing the workability of the form, xerox copies were made, and finally the form was sent to the printer for multiple copies.

All Research Assistants were assigned abstract analysis, and each accepted an in-depth specialized assignment: Helene Walczak - Job Ladders; Pat Kelley - Job-related Curriculum; Gary Lane - Orientation to the World-of-Work. This report is concerned with analyses of abstracts completed by the Research Assistants and synthesized by the Senior Research Planner in a report for the Director of the Vocational Academy.

Abstract Set I can be classified as follows:

	<u>Classification of Abstracts</u>	<u>Percentage</u>
1.	Related to Vocational Academy	43%
2.	Slightly related to the Vocational Academy	11%
3.	Unrelated to the Vocational Academy	46%
	Total researched	100%

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As there were 21 abstracts in Set I unrelated to the Vocational Academy, the staff agreed that the approach in Set II will be to first survey all the abstracts and to study, analyze, and write up only abstracts that are relevant to the tasks of the Academy.

A limitation of the analyses of relevant abstracts is the small number (20 out of 46) which has significance to the task of the Vocational Academy.

Foci of the Projects

Analysis of the projects reported in the abstracts show that from 1965 to 1978 only 30 of the projects in Set I were action projects for the disadvantaged (Minorities and women), i.e., skill training sessions. All others dealt with theory, recommendations, data collection and evaluations as follows:

	Number	Percentage
Action Projects	6	30%
Conferences, workshop for teachers, supervisors	3	15%
Speeches, papers	3	15%
Evaluations, reviews of Programs	6	30%
Testimony	1	5%
Data collection: Bibliography	1	5%
	20	100%

The workshops and conferences (15%) were held for teachers and supervisors of projects for the disadvantaged and were explicit in their title and goals, for example: Workshop for the Study of the Disadvantaged for Selected Teachers of Occupational Training. Forty-two teachers and supervisors met in an intensive two-week workshop "oriented toward understanding the life-styles of the disadvantaged with an examination of such factors as relevant socio-cultural concepts, the culture of poverty, minority group relations, and strategies and alternatives for solving the problems of the disadvantaged." An attempt was made to translate insight gained into "teaching goals and techniques." (Texas, July 1967)

Eleven years later (Ky. 1978), among other topics, at a Vocational Teachers Education Conference, a speaker from the National Advisory Council on Vocation Education critiqued vocational education leaderships dealing with the employment problems of the economically and academically disadvantaged. This national body evidently con-

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concluded that little progress has been made during the years by vocational education leadership in dealing with the problems of the disadvantaged.

Findings

The following findings are culled from the Abstract Analysis forms:

Most of the studies and projects on manpower training were generated in the 60's, and had economically disadvantaged minorities (Blacks, Mexicans, Puerto Ricans), as the target population.

Some of the studies were directed to minorities and the poor, while others made references to them in speeches, reports, conferences and workshops.

In the late 70's as the women's movement gained momentum, activities on behalf of women showed up in the literature, in the form of papers and reports on women workers, and testimony before the Council on the Economic Status of Women.

Geographically, 80% of the project reports were in urban areas and 20% in rural areas.

There was little or no reference in the abstracts to testing, counseling, placement, and supportive services. However, this is not to conclude that these services were not rendered. The abstracts by nature are brief, and the full reports of each project would be needed to ascertain the extent of counseling and supportive services. It is generally known by first hand contact with agencies, such as, Opportunities Industrialization Center (OIC), Training Resources for Youth (TRY), and Skills Advancement Incorporated (SAI), that counseling, support services and remedial courses were given. The research staff indicated that certain documents in toto would be helpful and 23 letters have been written requesting these materials.

Some of the abstracts (3) referred to curricula concerns, with one specifying "individualized curriculum." Several made references to "occupational literacy programs," "non-formal education, and the world of out-of-school learning," and the world of work." One innovative recommendation was to permit students to cross Federal, State and County lines to take tuition-free courses. SAI's abstract referred to "peer teaching." One project was experimental and referred to "control group." (Planned Change in Low-Income Rural Areas: An

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Evaluation of Concerted Services in Training and Education). It was the only one which discussed the effectiveness of the project, stating: "Some expansion of local industry occurred and several small industries located in the pilot areas. But the overall increase in local employment was not great." (Arkansas, Minnesota, New Mexico, 1969)

Future Literature Search

Descriptors being used in the ERIC data computer search have evolved with time and are now closer identified with the goals of the Vocational Academy. Set #II abstracts hopefully will provide data which will give some precedents to the three research components of the Academy: job-related curriculum, job ladders, and world-of-work orientation in the fields of health, electronics and business--occupational trends for the '80s.

Summary Statement

A general impression of the literature search so far is that it has not produced substantive data of use in designing an innovative, alternative training program for the Vocational Academy. The lack of such data plainly supports the rationale for the Vocational Academy in light of the increasing number of disadvantaged workers without formal education. Providing less literate workers with job-related knowledge, vocabulary and skills to work effectively in the private sector, appears to be uncommon in the world-of-work.

THE VOCATIONAL ACADEMY

Synthesizing Analyses of Abstracts

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Report II

July 22, 1980

Hilda O. Fortune, Ed.D.
Sr. Research Planner

As the Research Staff anticipated, descriptors more closely related to the program of the Vocational Academy as it evolved produced more relevant abstracts from Information Retrieval Services, namely, ERIC and National Technical Information Service (NTIS).

During the months of June and July, along with their Specialized Assignments, Research Staff members perused 91 pages containing 241 abstracts, averaging 2.65 abstracts per page. The selection of abstract Sets to be read by the Research Assistants was based on their specific forte, interests and assignments, namely:

Helene Walczak	-	Job Ladders
Patricia Kelley	-	Job Related Curriculum
Jim Kelly	-	Orientation to the World-of-Work and Performance Testing/Assessment

(See attached table)

Relevancy of Abstracts

Instructions for abstract analysis were stated by the Senior Research Planner, on May 27, 1980, in Memorandum #17 - 80: "Instead of reading abstracts and reporting on all seriatim, read and analyze only those of significance to the foci of the Vocational Academy."

A total of 52 abstracts in Batch II was analyzed by the Research Assistants on abstract forms developed for reporting. The 52 abstracts selected for analysis were subdivided and rated: 1-excellent, 2-good, 3-fair, according to the degree of significance to the program of the Vocational Academy. The classification is as follows:

TABLE II

<u>Classification of Select Abstracts</u>	<u>Percentage</u>
1 - Relation to the Vocational Academy - Excellent	25
2 - Relation to the Vocational Academy - Good	28.8
3 - Relation to the Vocational Academy - Fair	46.2
Total -	100.0 %

Abstract Contents

A model in the abstracts for the Job Ladder component of the Vocational Academy was a project at Hunter College, City University of New York, which designed a curriculum and job-ladder for trainees ranging from licensed Vocational Nurses to Registered Nurses. A prototype for a Job-Related Curriculum is the Mountain-Plains Education and Economic Development Program in Montana. This program for

disadvantaged families discussed its curriculum package, and Teacher's Guide; gave a specific example of a Learning Activities Program (LAP); and discussed its flow chart, monitoring and testing materials for LAPs.

For Orientation to the World-of-Work component and Performance Testing and Assessment Phase, there were little or no materials reported per se. However, throughout the reports there were a few referral notes from Patricia Kelly and Helene Walczak, Research Assistants, concerning the relevancy of materials which they read to Jim Kelly who is responsible for Orientation to the World-of-Work and Performance Testing/Assessment. Thus, a limitation of the abstracts in Batch II resulted in little material available to Jim Kelly, Research Assistant assigned to Orientation to the World-of-Work component and to Performance Testing/Assessment. Further, since Research Assistants have special assignments along with abstract analysis, it is not possible for each one to read all 241 abstracts. One Research Assistant may read materials in a Set which may be unrelated to his/her particular assignment but may have special relevancy for the assignment of another researcher. The remedy may be, if time permits, for each researcher to pick up on referral notes made by colleagues.

Foci of the Projects

The foci of most of the project presentations ranged from training programs, to reports and speeches.

Besides programs for trainees in the health field and for disadvantaged families, there were a scattering of projects for the disadvantaged and civil service personnel. However, the Mt. Plains Curriculum Package, the Mt. Plains Handbook, the Mt. Plains Education and Economic Development Program were comprehensive, and even mentioned training for electronics assemblers, a position being researched and developed by the Vocational Academy.

Abstracts in essence are very brief and consist of a concise description or simple reference. In order to further research the data, the original document must be obtained. If available, the original document may or may not elaborate on the particular subject of interest, say "electronics assembler," in our case.

Findings from the Research Data

Analyses of the projects reported in Batch II of the abstracts, with a rating of one (1) and two (2), showed -

- (1) All projects reported were conducted in the 70's (contrary to projects from the 60's reported in Batch I).
- (2) Projects were conducted in ten (10) states: New York, California, Ohio, Washington, D.C., Oklahoma, So. Dakota, Pennsylvania, Montana, Iowa, Illinois.

Synthesizing Analyses of Abstracts

- (3) There were some duplications and many spin-offs of abstracts from some projects which were reported by ERIC and National Technical Information Service (NTIS).
- (4) Due to the Spin-offs, the target groups were predominantly trainees in the health field, and family members in a variety of programs, ranging from training and placement to home management.
- (5) Career mobility was an overt or covert theme in many of the programs.

Literature Search

Because of the time limitation on the life of the Vocational Academy (Phase I), the feasibility of continuing to order materials is questioned, although requested by Research Assistants. Materials requested at this late date may not arrive until after the termination of Phase I. Some materials ordered in May are just now being received. Over forty (40) mail orders for materials have been made by the Director and Senior Research Planner, utilizing research contacts as well as following up requests from the Research Assistants. The response rate is fifty percent (50%)-- twenty (20) documents received.

Rather than request further ERIC abstract searches with additional descriptors, literature and documents received by mail, as well as data collected on field trips, will be available to Research Assistants for analysis. The reporting form has been revised to accommodate books and journals as well (See form attached).

Summary Statement

Although limited in variety and subject matter in comparison with Batch I, the large number of spin-off abstracts from fewer projects in Batch II have been meaningful. They produced data more closely related to the research emphases of the Vocational Academy.

All of the 52 abstracts analyzed were related to the program of the Vocational Academy, with 54% having an excellent or good relationship. Future research literature analyses will be directed to books, journals and other materials being received in response to mail requests and field trips. Hopefully, this approach will be more helpful to research in Orientation to the World-of-Work and Performance Testing/Assessment.

If time permits, and if the Health component of the program is to be refined, the Research Assistants can further examine the health theme emphasized in Batch II.

TABLE I

Specialized Assignments/Abstracts Related Table

Name	Specialized Assignments	Batch II - Set Title	ERIC-NTIS Abstracts		Reported (on abstract forms)			
			No. of Pages	No. of Abstracts	Rating 1	Rating 2	Rating 3	Total
Helene Walczak	Job Ladders	Career Ladders and Vocational Education	77	203	10	7	14	31
Patricia Kelley	Job-Related Curriculum	Curriculum and Economically Disadvantaged and Vocational Education and Demonstration Project	9	28	2	6	5	13
Jim Kelly	Orientation to the World-of-Work; Performance Testing & Assessment	Dropouts and Vocational Education	5	10	1	2	5	8
Totals -			91	241	13	15	24	52

DATA ANALYSIS

Date _____

Name _____

Number: _____

Page _____

I. Identifying Data

Author

Title

Journal: Source. Volume: Page, Year.

Book: Place of Publication; Publisher; Year.

II. Content Data

III. Analysis

Rating (As relates to Vocational
Academy: 1 Excellent, 2 Good,
3 Fair, 4 Poor, 5 Fail)

*Recommendations for
Vocational Academy

IV. Comments

7/3/80

ABSTRACT ANALYSIS

Date _____ Name _____
 Number _____ Source _____ Page _____

I. Identifying Data

<u>Project Title</u>	<u>Site</u>	<u>Sponsor</u>	<u>Funding Source</u>	<u>Year and Length of Project</u>	<u>Population</u>				<u>Economic Category</u>
					<u>No.</u>	<u>Age</u>	<u>Sex</u>	<u>Ethnicity</u>	

II. Content Data

<u>Skills Training</u>	<u>Placement</u>	<u>Support Services</u>	<u>Educational Services</u>	<u>Testing</u>
------------------------	------------------	-------------------------	-----------------------------	----------------

III. Analysis

Results (Placement rate high, longevity, other significant factors)

Rating (As relates to Vocational Academy: 1 Excellent 2 Good, 3 Fair, 4 Poor, 5 Fail)

*Recommendations for Vocational Academy

*Comments

*You may use other side if needed.

SECTION I

AN ALTERNATIVE METHOD OF TRAINING FOR
HEALTH CAREER OCCUPATIONS:
THE VOCATIONAL ACADEMY APPROACH

Presented by:
Helene Walczak
Pat Kelley

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HEALTH RESEARCH

Introduction

In May 1980, the Vocational Academy research staff of Nova University was charged with the responsibility of developing an innovative alternative approach to vocational education for the economically disadvantaged. This innovative approach was to incorporate a career ladder concept in skills training and research the usual pitfalls in adult education which befall minorities and economically disadvantaged individuals. Preliminary investigation revealed the fastest growing labor manpower personnel needs in Florida were in the fields of health, business, security and electronics. It was decided to apply the Vocational Academy concepts to the health field first.

Among the questions posed in this first research project were:

- 1) What is a job ladder? How could the concept be applied to the health field?
- 2) How could training be tied to the career ladder concept? How could an appropriate curriculum be developed?
- 3) Would such a program be feasible?
- 4) Had similar programs been established in the past? If so, what factors made them successful or unsuccessful?

It was hoped that by researching these questions a foundation could be laid for constructing a workable model incorporating Vocational Academy concepts. This paper represents the attempts of the research assistants to lay this foundation and answer the above questions.

Review of the Literature

Historical Trends in Vocational Education

The Vocational Education Act of 1963, which offers matching funds for a wide range of services and training in many different skills, has stimulated the growth of area technical training centers in many parts of the United States. An area technical program can be:

- 1) A high school that specializes in vocational training.
- 2) Part of a high school used to train in vocational education.

- 3) A vocational school that trains people who have finished or left high school.
- 4) A division of a junior college that provides vocational education.

The goal of any of these local programs is to provide training for a variety of jobs available in their geographical locations.

The response to technical training programs has not been uniform. Articles discussing the assets and disadvantages of vocational education range from claims that vocational education is merely a training program for entry level jobs--leaving industry to retrain workers (Braden & Paul, 1979), to a system capable of attracting new industry and providing new jobs for all who need them (Morris, 1979).

Several area technical schools have received special recognition for outstanding placement rates and contributions to their communities. Among these programs which will be described are:

Murrell Doblins Area Technical School, Philadelphia, Pennsylvania

Phillip Randolph Skills Center in East Falls Philadelphia, Pennsylvania

Career Employment Program, Jefferson County, Alabama

Vocational School Department, Worcester, Massachusetts

South Carolina State Board for Technical and Comprehensive Education, Columbia, South Carolina

Project Cooperation, Salt Lake City, Utah

The Murrell Dobbins Area Technical School was founded in 1938 and serves 45% low income-families. This high school program emphasizes academic skills as well as vocational training; academic courses are taught at several levels, including college preparatory. The skills training includes instruction in secretarial skills, computer programming, accounting, art, chemistry, architecture. This school boasts a record of high academic achievement, very low teacher turnover, graduates accepted for admission in good colleges, and students finding employment in jobs paying more than minimum wage.

The Phillip Randolph Skills Center (Philadelphia, Penn.) offers seven occupational clusters with 31 course offerings. Technical material is broken into small segments. High school

students enrolled in this program continue to attend academic classes half a day at their local high schools. The Center reports that a 53% of the students are placed in fulltime jobs directly related to their training, 10% in unrelated jobs, 9% in armed forces and 20% in post-secondary schools.

The Career Employment Program (Jefferson County, Alabama) provides industry approved skills upgrading for adults and skills training for youth. The school works very closely with industry in order to match skills training to existing jobs. Academic upgrading to prepare students for General Equivalency Diploma (GED) is also available on a voluntary basis.

The Vocational School Department in Worcester, Massachusetts offers courses in nurse's aide, small engine repair, carpentry, transportation, warehouse work, culinary arts, child care, book-keeping, ward clerk, computer technician, and electronic technician training. The school is geared toward economically disadvantaged students and English is offered as a second language. The school claims a 10% placement rate.

The South Carolina State Board for Technical Education (Columbia, South Carolina) operates 16 technical colleges and centers in the state, which brings 75% of the states population within 30 miles of a technical center. Skills upgrading, as well as instruction in new trades, is offered through 153 curricula. This program has been operational since 1961 and it is distinguished by its flexible and varied programs. Adult basic education, college courses, and GED courses are available. Proponents state this program has facilitated \$10 billion in new industry brought into the state.

Project Cooperation (Salt Lake City, Utah) provides classroom hands-on training, in-school work experience, and on-the-job training. The program is geared toward youth who have experienced failure in the traditional school setting. The program is viewed as one of the most innovative in the United States. Included as part of training are career awareness, job seeking skills training, and academic instruction needed for the specific vocational training.

These successful programs often include two aspects which are recognized as crucial by Short and Levine (1979). There should be a great amount of flexibility in the skills training provided, with the schools and the industries working closely to choose which skills should be taught and at what levels. The direction of manpower development should be decided on the basis of a combination of three indicators: the socio-political beliefs and systems in the area, the economic conditions in the area, and the supply-demand characteristics of the area job market (Norris, 1977). If the schools offering vocational training are not in tune with these issues, they run the risk of training people for nonexistent jobs. It is essential that the program works closely with Private Industrial Councils

(PIC- Title VII of Comprehensive Employment and Training Act), and involves the local business and union leaders in discussions and decisions (Short & Levine, 1979; Olson, 1980; Braden & Paul, 1979).

The American Vocational Association's (AVA) Legislative Study Teams have made several recommendations which are pertinent to local training programs:

- 1) Increase innovation in designing programs to train at higher than entry level skills,
- 2) Provide higher technical competencies that allow trainees to create new opportunities for themselves,
- 3) Make sure programs meet the needs of the trainees and the industry,
- 4) Continue literacy training as part of the vocational education, but as a legitimate part of the training and not a repeat of previous traditional school failures,
- 5) Prepare students to enter the work world by use of work experience, hands-on training, and follow-through support services (Olson, 1980).

Career Ladders - Methodologies

Although the term career ladder has come into vogue recently, the same concepts have been prevalent for a long time under the terminology "social mobility," "occupational hierarchy," and "occupational mobility." Traditionally, these terms have referred to the prestige and status associated with professional positions rather than entry or mid-level positions. Since 1974, the Department of Labor has emphasized the importance of career ladders in training programs for the economically disadvantaged. The career ladders concept, as termed by the Department of Labor, has usually referred to upgrading of skills on the job through a promotional system (Rodriguez, 1978).

The United States Air Force has been a pioneer in career development. The Air Force Occupational Measurement center at Lackland Air Force Base in Texas has completed extensive job analysis for numerous careers within the Air Force. After developing a survey instrument this center:

- 1) Obtained information about skills required at each job
- 2) Summarized tasks by skill levels
- 3) Developed career ladders for each occupation
- 4) Examined education and training required of each skill level
- 5) Compared measures of job satisfaction with career ladder position
- 6) Made recommendations for change

Similar smaller scale job analyses and career ladders have been developed by private industry. The food service industry, for example, has subsidized research on career ladders related to food production and hospitality occupations. Career ladders have also been developed by several government agencies for occupations within the public sector.

All of the foregoing have emphasized acquisition of skills on the job. Research concerning curriculum or vocational education based on career ladders is scanty.

The most comprehensive investigation of career lines was performed by Spillerman (1978). He uses the term career "tree" to describe the many lines possible in pursuing a career. Lines can be horizontal, vertical or diagonal. Some careers have a single port of entry with a minimum educational requirement at that level. An example is the police field. A person can only be a police lieutenant by working as a police officer first. For most occupations, however, a particular position can be obtained through upward movement on the job or outside the port of entry in which education is substituted for work experience. Spillerman points out that industrial characteristics and special features of the labor market may also influence the shape of career lines.

Recently the Department of Labor has emphasized the concept of upgrading of skills for economically disadvantaged workers. Upgrading is the process by which a person employed at the entry level then obtains the education and vocational skills necessary to move up the career ladder. The Atlantic Area Technical School has a very close working relationship with local employers to upgrade the skill level of employees. The school also offers part-time training off campus and directly at job sites. Granick (1973) describes an upgrading demonstration project in a small manufacturing company. At

this company, a diagonal/vertical career ladder system was tied to on-the-job skills training and off-the-job basic education. In a nine-month period, 58 people were hired at entry level positions, and 19% of them were promoted into jobs requiring more advanced skills.

Health Career Ladders

The health field consists of many different clusters of occupations including science and engineering, social work, technical instrumentation, health services administration, medicine, nursing, pharmacy, psychology, laboratory services, dentistry, dietetics, and health education (U. S. Department of Labor, 1979). Each of these clusters could probably generate separate career ladders.

A Health Service Mobility Study was sponsored by Hunter College and N.Y. City College Research Foundation, with funding by Employment and Training Administration in Washington, D. C. This four-year study, reported by Eleanor Gilpatrick (1977), performed job analysis of various health occupations, and made recommendations for future training and employment. An extensive model was developed for a radiology career ladder. In this model job-related behavioral curriculum objectives were developed for three levels of the career ladder: aide, technician, and technologist. These curriculum objectives were used to develop educational ladders to parallel recommended job ladders. A newly defined job, quality assurance technician, was identified as part of the ladder.

The State of Louisiana offers a vocational training ladder in nursing. The progression is from Nurse's Aide to Licensed Practical Nurse (LPN) to Registered Nurse (RN). Students can enter the ladder at either the Nurse's Aide level or the LPN level and successful exits can be achieved at any of the three levels. This appears to be a comprehensive approach; other authors (Rosen, 1968), (Arkansas State, 1972), Fasano, 1976) describe models for advancing from nurse's aide to LPN or from LPN to RN.

Taub (1972) proposes a model of individualized instruction for clinical laboratory occupations. This model enhances career mobility by establishing a curriculum with self-contained instructional segments.

Field Information

Several schools in Broward County offer training in health related fields. Attempts were made to obtain information about these programs through field visits, telephone contacts, and

perusal of catalogues. The following report summarizes the information gleaned from these contacts. Due to time constraints it was not possible to investigate all the facilities in Broward County offering health related training. Therefore, this list is not intended to be comprehensive.

The School Board of Broward County

- 1) Sheridan Vocational School
5400 Sheridan Street
Hollywood, Florida

The Sheridan Vocational School offers one year certificate programs for Licensed Practical Nurse (LPN) and Certified Laboratory Assistant (CLA). A high school diploma is recommended for admission to these programs and the student must pass an entry examination for admission. Upon passing the test, which reportedly measures reading comprehension, the student is placed on a waiting list and it may take nine months to one year before admission. The LPN and CLA programs involve classroom instruction as well as practical experience in hospitals. The curriculum is geared towards preparing students for the State licensing examinations.

Sheridan Vocational School also offers programs which prepare students for employment as nursing assistants and hospital unit clerks.

- 2) Carver Ranches Center
2201 S. W. 44th Avenue
West Hollywood, Florida

This school offers a three month program which prepares students for employment as home health aides. The program, which has been in existence for approximately one year, is geared towards economically disadvantaged students.

Private Schools

- 1) Charron-Williams College
417 South Andrews Avenue
Fort Lauderdale, Florida

Charron-Williams College offers training which prepares students for employment as medical assistants, clinical laboratory technicians, medical receptionists, dental technicians and nurses aides.

- 2) The Keiser School
2840 East Oakland Park Blvd.
Fort Lauderdale, Florida

This school offers training which prepares students for employment as dental assistants and medical assistants.

- 3) Meddow Academy
2450 Hollywood Blvd.
Hollywood, Florida
1925 N. E. 45th Street
Fort Lauderdale, Florida

The Meddow Academy offers three month programs which prepare students for employment as home health aides and hospital unit clerks. A sixth grade reading level is recommended for admission into the Home Health Aide program. The Meddow Academy also has had a successful history of training economically disadvantaged students and placing them on jobs.

Colleges and Universities

Broward Community College (BCC)
3501 S. W. Davie Road
Davie, Florida

Broward Community College's Allied Health Division offers degree and certificate programs in many health related areas. Among the offerings are training in Emergency Medical Services, Radiology, Ultrasound, Registered Nursing, Medical Laboratory Technology and Dental Assisting.

BCC and Sheridan Vocational School have a cooperative relationship concerning their nursing and laboratory services program. Students who successfully complete the one year LPN program at Sheridan Vocational can bypass the first year of the registered nurse program and immediately enter the advanced nursing classes. Also, students who complete the Certified Laboratory Assistant program at Sheridan Vocational School can apply their training toward an Associate Degree for the Medical Laboratory Technician.

Recommendations for Vocational Academy - Sample Career Ladders

In line with Vocational Academy objectives, sample job ladders were developed for the field of laboratory services and

direct patient care. These sample career ladders can be seen in Tables 2A and 2B.

TABLE 2A
PATIENT CARE CAREER LADDER

		CAREER STEP IV	
		Job Title: Registered Nurse (R.N.) (D.O.T. 075.374-010)	Job Duties: executes physician's orders provide treatment as ordered by the physician, supervise health care personnel who perform routine duties—often specialized duties (e.g. surgical, psychiatric, pediatric)
		CAREER STEP III	
		Job Title: Licensed Practical Nurse (LPN) (D.O.T. 079.374-014)	Job Duties: give injections, apply compresses, change dressings, give medications, lift patients, report symptoms
		CAREER STEP II	
		Job Title: Nurse's Aide or Nursing Assistant (D.O.T. 355.674-014)	Job Duties: recording temperature, pulse, blood pressure, food intake, drape patients, change beds, dress and undress patients, and transport patients
CAREER STEP 1			
Job Title: Home Health Aide (D.O.T. 354.377-014)			
Job Duties: giving bed baths, preparing meals, doing laundry, cleaning patient quarters, food shopping			

Levels One and Two of the Patient Care Career Ladder are very similar. The Home Health Aide (D.O.T. 354.37-014) provides basic care in the patient's home. Job duties include giving bed baths, preparing meals, doing laundry, cleaning patient quarters, etc. Some of these duties are very similar to those performed by domestic workers.

Level Two, the Nursing Assistant (D.O.T. 355.674-014), is sometimes termed nurse's aide or hospital attendant. Nursing assistants also are involved in direct patient care--however, their duties involve more of a medical care aspect than those of the home health aide. The nursing assistant usually works in a hospital or nursing home. Duties can include recording temperature, pulse, blood pressure, food in-take; draping patients, changing beds, dressing and undressing patients; and transporting patients.

Ideally, students should be able to advance from home health aide to nursing assistant according to the career ladder concept. In practice, however, students enter either the home health aide or the nurse's aide training program.

Level Three of the Patient Care Career Ladder is the Licensed Practical Nurse (D.O.T. 079.374-014). At this level ability to read and comprehend written instructions become crucial in training and on the job. Training involves some knowledge of anatomy, physiology, medication, nutrition and specialized patient care in medical, surgical, pediatric, geriatric, maternity and psychiatric wards. Since job duties can include giving injections, applying compresses, changing dressings, giving medications, lifting patients, etc., mistakes in job performance are serious.

From Level Three it would be feasible and logical for students to progress to Level Four, which is the Registered Nurse (D.O.T. 075.374-014). Depending on the students' preferences and ability, training may vary from preparation for an Associate Degree to a Bachelor of Science degree. The registered nurse executes physician's orders and provides treatments ordered by the doctor.

Depending on the type of degree the student chooses, the curriculum could include courses in sociology, psychology, biology, nutrition, pharmacology, nursing fundamentals and nursing specialties. Both the LPN and RN (Levels Three and Four) must pass State licensing tests.

The Laboratory Service Career Ladder of the Vocational Academy also contains four levels. Level One is the Medical Assistant (D.O.T. 079.-367-010). Most medical assistants work in doctors' offices, where, along with their specialized technical services, they often perform a variety of clerical duties. They were designated as the first Level due to the simple laboratory duties which they perform, such as, sterilizing instruments, checking equipment, collecting blood samples, and performing simple blood tests.

Level Two, the Certified Laboratory Assistant (C.L.A.), (D.O.T. 078.381-014) performs more complicated clinical duties, such as, collecting specimens, drawing blood, preparing slides, grouping and typing blood, and examining fluids and blood under a microscope. The Certified Laboratory Assistant must also pass a state licensing test which assesses knowledge of hematology, urinalysis, microbiology, immunology, immunohematology, laboratory solutions, medical terminology, and handling of biological specimens.

Level Four, the Medical Laboratory Technician (D.O.T. 078.381-014) requires an Associate Degree in order for students to pass the state licensing test. The medical laboratory technician differs from the C.L.A. in that job duties require more independent judgement in performing clinical laboratory tests. Thus the student needs a more general background in chemistry, biology, and scientific principles, and a knowledge of intermediate algebra is required as well as good basic academic skills. The student also may learn to operate complicated instruments, including computerized equipment.

For two reasons, Level Four, Medical Technologist (D.O.T. 078.361-014) is a questionable step on the Vocational Academy career ladder. First, it requires a four year college degree which many economically disadvantaged individuals would have difficulty obtaining due to limited financial resources and academic background. Secondly, this type of degree is currently not available in Broward County schools. It is included here for the benefit of the occasional exceptional student with high aspirations. Information about this advanced phase of the career ladder could be disseminated during orientation. At the end of Level Three, the student also could be advised where to continue training without the assistance of the training institution. The medical technologist performs complicated tests which require considerable independent judgement and also operates special apparatus and precision instruments.

Competency-Based Curriculum

Levels Three and Four of the Patient Care Career Ladder and Levels Two, Three, and Four of the Laboratory Service Career

Ladder require good academic skills. This may pose a barrier to many economically disadvantaged clients.

Instruction in basic education competencies, particularly math and reading, has been a point of discussion in vocational education since the 1940's. There are 6,500,000 people between the ages of 16 and 24 in the United States with less than four years of high school education, according to a former United States Commissioner of Education, Ernest L. Boyer. Mrachek (1980) feels that we should not eliminate traditional education, but it should be more practical and tied to everyday needs. "Life skills" or "survival skills" can be taught in technical vocational schools through practical applications to job skills, and through the use of materials appropriate to the age of trainees. The motivating factor in teaching life skills is relevancy (Sedlik, 1980). Instruction in math and language arts should be in the context of a specific job or career. Both the job skills and the life skills can be learned through Learning Activity Packages (LAPs), which are individualized instruction programs which the student can master at his or her own speed (Sedlik, 1980). Materials used in traditional schools are not appropriate for vocational schools, and materials for the adult reading on a sixth grade level should not be on a sixth grade level in a social context or interest areas (Whitehead, 1979).

Instructional techniques and procedures should be related as closely to real job conditions as possible, e.g., a laboratory assistant should learn by using laboratory equipment, and not by watching someone demonstrate or reading from a book. Learning techniques should also allow the student to make as many correct responses as possible in short periods of time (Maeger & Beach, 1967). The small units of instruction should be sequenced from general to specific, and there should be advancement from one skill to another so that students progressing through the course can be certified for certain skills as they go along. Those skills needed or used most often in a job should be emphasized in the first training curriculum. It is imperative that the student be allowed to practice the function of the entire job before the course is finished (Maeger & Beach, 1967).

It is suggested that the Vocational Academy consider changing the health services curricula into individualized programs set up in LAPs allowing open-ended entry into the program. If the programs were individualized, basic skills training could be incorporated into the courses, allowing entry into programs with lower reading and math skills. However, because of licensing requirements and standards set by medical employers, it is unrealistic to assume that these basic skills need not be remediated.

If students were allowed to learn in a hands-on manner with reinforcement after small accomplishments, the motivation to remain in the program would improve, and learning might be more effective. Use of students at higher levels to instruct or assist those at lower levels allows continued motivation, reinforcement of learning, and the development of interpersonal job related skills.

Evaluation of programs at the Vocational Academy need to be skills/performance oriented. If operational objectives have been established with LAP's developed to teach those objectives, testing of the skills should be easily accomplished. Actual performance of skills with periodic certification as the student progresses through the course is desired. For effective evaluation of a student's progress, the goals and objectives of the program must be clearly stated, the tasks necessary to demonstrate accomplishment of the objectives must be identified, and the student must be required to perform the tasks for the evaluator (Fink & Kosecoff, 1978).

Summary

In constructing a model career ladder, the Vocational Academy staff discovered several obstacles which would interfere with implementation of the model.

The first obstacle encountered was state licensing laws. A second related difficulty was posed by the problems in establishing an innovative training program for the health field. If the program were implemented and proved unsuccessful, patients could be exposed to inept employees, thus raising the issue of malpractice.

A third observation was the finding that present medical training programs appear to be successful in meeting employer's training needs for qualified health workers. Furthermore, the career ladder concept was already being partially implemented by allowing students at BCC to receive credit for courses taken at Sheridan Vocational School.

Many health occupations require state licensing after training. However, occupations which do not require state tests would present students in a positive manner if they possessed certificates qualifying them to perform all of the tasks required to work satisfactorily.

A fourth difficulty was that even the Level One entry positions could be out of reach for some potential CETA eligible clients with limited formal education. For example, a high school diploma is recommended for the Level One position of Medical Assistant. For these reasons, the Vocational Academy staff decided not to pursue additional development of the career ladder model for the health field.

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SECTION II

THE VOCATIONAL ACADEMY APPROACH TO
THE ELECTRONICS INDUSTRY IN BROWARD COUNTY

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THE VOCATIONAL ACADEMY APPROACH TO THE ELECTRONICS INDUSTRY IN BROWARD COUNTY

General Introduction and Literature Review

With the expanding industrialization of the cities, and the growing demand for specialization of skills that are needed to obtain and hold even entry-level jobs in industry, large numbers of unskilled laborers have found it increasingly difficult to find jobs (Quales, 1979). Employers and educators have looked to the educational programs of our cities to find new and creative ways of dealing with these problems (Tussing, 1976).

Many of the solutions proposed include the use of manpower programs and job placement services. Some critics suggest that graduates of manpower and vocational programs and unskilled workers simply "bump" other unskilled workers from available jobs at "dead-end" or entry level and do not create new jobs or aid workers in advancing to higher level jobs (Tussing, 1976). Tussing states that only by speeding up the growth of industry in local areas and thus creating new jobs can we begin to solve the problems of unemployment in our present economy. Educating more untrained, unemployed people for jobs, without at the same time increasing job availability, will not help (Tussing 1976). Although this is not the only approach to the solution of unemployment, it is the solution that fits the rising unemployment problems in Broward County, an area with an increasing number of unskilled workers each year due to the immigration of Cubans, Haitians, and migrant workers.

Two programs that have attempted to attack unemployment of unskilled workers aggressively are the Industrial Training Program (ITP) of the State of Maryland, and the National Training Fund (NTF) of the Sheet Metal and Air Conditioning Industry.

The Industrial Training Program in Maryland both trains new workers and retrain present workers for the local mining industries. Project training committees are established to determine current industry needs and to write a training curriculum. Training is provided for specific companies with the specific skills needed by each emphasized (Raven and LeFiles, 1979). Goals of such a program must be to provide enough knowledge for the employees to work safely and efficiently, to impress on the workers the importance of the industry to themselves and their community by providing jobs, and to enable the workers to understand, adjust, and service the equipment they use regularly (Raven and LeFiles, 1979).

NTF has discovered the necessity for anticipation of the need for new skills that must be taught, along with the elimination of out-of-date skills in classes. Development of new courses of instruction as the needs of established industries

change or new industries move to the area, as well as annual instructor workshops, receive high priority. Research to identify future needs of the employers and employees and new training aids, along with opportunities for vocational instructors to upgrade their skills, are important parts of their policy (Fillippina, 1979). For example, since 1974 NTF has developed new courses in solar heating and other uses of solar energy to meet the anticipated needs of the heating and air conditioning industry in the future.

Encouraging local industrial growth, training unskilled workers for the types of jobs available in the area, and working with local industry to make vocational courses meet their needs are the important aspects that must be emphasized in any vocational program. These programs not only aid specific workers to get jobs, but will aid in increasing the number of available jobs and the ability of workers to advance to higher jobs as they learn. The electronics field is a growth industry that offers excellent opportunities for advancement.

Electronics Overview

Electronics is that branch of science and technology which deals with the study, application, and control of the phenomena of conduction of electricity in a vacuum, in gases, in liquids, in semiconductors, and in conducting and superconducting materials.

The Department of Labor (1977) carefully differentiates the electronics and electrical equipment industries. According to the Department of Labor (DOL):

Electronics Industry: This designation includes occupations concerned with manufacturing of electronic equipment and components. Electronic equipment is characterized by the use of electron tubes or semiconductor devices in its principal function. Items that are considered electronic equipment include radio and television receivers and transmitters, detection and tracking apparatus and systems, test equipment, power supplies industrial monitoring and continuous control systems, and sound distribution equipment

The DOL then proceeds to define and itemize electronic components. Among the components listed are resistors, capacitors, transistors, diodes, flip-flops, gates, computer logic modules and filters. (See Appendix for definitions of these and other components.)

The DOL identifies the electrical equipment industry as including occupations concerned with the manufacture of "machinery supplies, and apparatus that are used in the generation, transmission, distribution, storage, and utilization of electrical energy."

It divides electrical products into four categories:

- 1) Electrical machinery, e.g. fans, generators, motors
- 2) Electrical appliances, e.g. meters, automotive electrical equipments, heating devices
- 3) Electrical devices, e.g. batteries, circuit breakers
- 4) Electrical supplies, e.g. bases, coils, fuses, light bulbs

Other related industries which are differentiated by DOL include lighting fixture industry, refrigerator, ice making, and phonograph industries.

History and Outlook for Electronics Nationally

The electronics industry in the United States dates back to the early 1920's when the first radios were produced. The industry diversified during World War II to include defense equipment. With the development of the computer and television, the electronics industry continued to expand steadily. Currently, the manufacture of electronics products can be divided into four market areas:

- 1) Government purchases - missile and space guidance systems, communication systems, and electronic goods used in medicine, education, crime detection, and traffic control.
- 2) Consumer products - television sets, radios, microwave ovens, stereos, calculators.
- 3) Industrial purchases - computers, radio and television broadcasting equipment.
- 4) Components which are usually divided into three broad groups:
 - A) Electron tube - device that typically consists of a sealed glass bulb containing two or more electrodes and used to amplify, generate and rectify electric oscillations and alternating currents.
 - B) Semiconductor - substance in which electric conductivity at normal temperature is intermediate between that of a metal and insulator e.g., transistor.

- C) Passive components - devices which regulate or alter electric energy. This category includes capacitors, transformers, relays, connectors, and switches.

The fastest growing market for electronics manufacturing has been the computer field. The first true electronic computer became operational in 1946 at the University of Pennsylvania; however, it was the invention of the transistor by Bell Laboratories in 1948 which made computers practical. Transistors served all the functions of a vacuum tube at a fraction of the size. As transistors became smaller, easier and cheaper to mass produce, they were wired more frequently onto circuit boards. The circuit boards were then placed in sequence to make computers. Eventually, transistors were packed by the thousands onto silicon chips and interconnected to form an integrated circuit (Sleight, 1980).

The development of the microprocessor in 1971 ushered in the microelectronic age. A microprocessor is an integrated circuit which contains all the circuitry needed to perform the central process of a computer. When memory devices and input/output devices are added to the microprocessor, it becomes a microcomputer. The development of silicon chips eliminated the need for wires in computers. Instead, circuits are printed on the silicon; the current then passes directly through the solid medium of silicon and is routed by the minute printed circuitry (McWhorter, 1978). In many instances this digital circuitry is now replacing analog computers, which solved mathematical problems by using physical analogues (such as shaft rotations of the numerical variables in the problem).

This rapid technological growth has been accompanied by related employment opportunities. Almost one fourth (23.6%) of all new jobs created in manufacturing during the post war period between 1947 and 1962 were in electronics. Today, electronics is the fifth largest manufacturing group in the nation and provides more than 1,000,000 jobs.

According to the Department of Labor statistics, employment in electronics manufacturing is expected to increase faster than the average for all industries through the mid-1980's. The greatest needs are anticipated for engineers, scientists, technicians, and skilled equipment maintenance workers.

Occupations in Electronics Industry

Due to the diversity and specialization found in the electronics field, a wide variety of electronics jobs exist.

Approximately half of electronics manufacturing employees work in plant operations of assembly, inspecting, machining, fabricating, processing, coil winding, and maintenance.

Assemblers make up the largest group of electronics industry employees. Skills required in assembly occupations are reflected in the Dictionary of Occupational Titles. Among the skills described for Electronics Assembler (D.O.T. 726.684-018) are:

- 1) Mounts assembled components such as transformers, resistors, capacitors, integrated circuits, and pockets on chassis, panel, or printed circuit board.
- 2) Tends machines or uses handtools to solder, rivet, weld, bolt or secure parts in place.
- 3) Connects component lead wires to printed circuits.
- 4) Tends automatic assembly equipment which joins components and parts.
- 5) Winds capacitors on manual or automatic winding equipment.
- 6) May perform assembly operations under microscope or other magnifying device.
- 7) Adjusts or trims material from components such as capacitors and potentiometers.

Related jobs which involve preparing components or parts for assembly are included under the general job description of electronics worker (D.O.T. 726-687-010). Among the occupations included in this category are encapsulator, wire worker, capacitor assembler, insulator assembler, crimper, die caster, tinner, wire stripper, rectifier-plate charger.

Thus, entry level positions in electronics run the gamut from tending automated machinery to precision assembly involving great patience, fine manual dexterity, and excellent vision.

Some electronics assemblers are able to advance to positions as testers, inspectors, or laboratory assistants. As with assembly positions, there is a considerable range of tester or inspector positions.

During manufacturing, components are usually checked manually or routed mechanically through automated test equipment. Many workers who perform these tasks are simply called testers or inspectors, while other workers have job titles which reflect the type of component they inspect, such as coil tester (D.O.T. 726-684-026). Other inspection jobs require electronics technicians who have years of experience in the

manufacture of computers or spacecraft. This diversity is reflected in the Dictionary of Occupational Titles.

An Electronics Inspector I (D.O.T. 726.381-010) is also known as a systems inspector or quality control inspector. This worker may examine wiring, cables, subassemblies, hardware and components to detect assembly errors. The Electronics Inspector I also locates soldering defects; may resolder broken connections; records inspection data, such as, serial numbers, type and percent of defects and rework required; may stamp inspected equipment to indicate acceptance; and may perform functional and operational tests, using electronic test equipment, such as frequency meters, oscilloscopes, and signal generators. This worker may be designated check inspector, in-process inspector, or final inspector, according to the production stage.

The Electronics Inspector II (D.O.T. 726.684-022) is also known as a visual inspector, line inspector, checker, or component parts inspector. The Electronics Inspector II inspects electronic assemblies, subassemblies, parts, and components by comparing them with samples or product illustrations. This job title often reflects the type of item inspected: capacitor inspector, cathode-coating inspector, connector inspector, filter inspector, grid inspector, printed-circuit board inspector, resistor inspector, semiconductor inspector, television-chassis inspector, or tube-inspector.

The Electronics Tester I (D.O.T. 726.281-014) is also known as a test systems technician, systems tester, trouble shooter, quality-control assembly test technician. The Electronics Tester I performs electronic, mechanical, and electromechanical tests on electronic systems, subassemblies, and parts to insure functioning according to specifications. Sometimes this tester also determines the cause of unit failure by using electronic test instruments. The duties required to fulfill this function vary according to the unit being tested. Consequently these workers may also be known as memory-unit test technician, television receiver analyzer, transmitter tester, tube-test technician.

The Electronics Tester II (D.O.T. 726.684-026) is also known as component tester, production tester, quality-control tester, or testing-machine operator. This tester also tests electronic function of assemblies, components, and parts, using standard test equipment and procedures. Test instruments commonly used include ohmmeter, voltmeter, ammeter, or oscilloscope. This worker may also reject defective units; record types of defects, verify dimensions of parts, operate special viewing equipment to observe internal image of units prior to testing. Depending on the units and type of testing involved,

these workers may also be known as capacitor tester, filter tester, printed-circuit tester, resistor testor, or tube tester.

Relatively few testers or inspectors advance to electronics technician positions, as the technician position requires specialized training in college, technical school, the Armed Forces, or company operated classes. There is some overlap between job descriptions of electronics technicians and assemblers or testers. Electronics Technician (D.O.T. 003.161-014) also assembles and tests electronic equipment. However, they also apply electronic theory, principles of electrical circuits, math, physics and related knowledge to build, repair, and modify developmental and production electronic equipment. At times the technician may also be called upon to draw sketches, recommend changes in circuitry, analyze and interpret test data, write technical reports, operate machine tools, or supervise lower grade technical personnel. Depending on the area of specialization, the electronics technician may be termed computer-laboratory technician, developmental-instrumentation technician, electronics communication technician, nuclear-reactor electronic technician, systems-testing laboratory technician or engineering development technician.

Some electronic technicians take on the duties of a "junior engineer" or "super technician", as they are known in the industry. These technicians assist electronics engineers (D.O.T. 003.061) in the design of test control apparatus and may recommend design modifications to eliminate causes of malfunction. Like electronics technicians, electronics engineers also specialize in a variety of areas such as the design and implementation of solid-state circuitry in radar, computers, and calculators.

Field Visits

There appears to be a shortage of skilled technicians and electrical engineers in Broward County. Most of the large companies recruit their technicians from outside of Broward County. They vie with each other for skilled technicians; unfortunately, many of the recruits do not choose to stay in Broward County and they relocate to areas with a lower cost of living.

The local schools have scrambled to meet industry's needs for trained employees.

Broward County School Board Vocational Training

The School Board offers electronics related courses at Atlantic Vocational, Manpower Training Center, B. F. James, Northeast High School, Coral Springs High School, Miramar High, and Nova High School.

The School Board's offerings can be divided into four areas:

1) Electronic Chassis Assembly offered at:

Atlantic Vocational Center
Manpower Training Center
B. F. James Adult Center

These courses involve five to seven weeks of hands-on experience in assembling chassis and printed circuit boards of diverse electronic equipment including radios, radar, computers, weapon control systems. Color coding, identification of electronic components, and soldering are taught trainees to prepare them for entry level positions.

2) Communications Electronics offered at:

Coral Springs High School
Miramar High School
Northeast High School
Nova High School

This program deals with the basics of electronic circuitry (resistors, inductors, and capacitors) and progresses through integrated circuit theory. Communications equipment circuitry is constructed and troubleshooting techniques introduced. This program prepares students for communications equipment repair.

3) Radio and Television Service, a similar course is offered at Atlantic Vocational Center.

This course emphasizes construction, maintenance, installation and repair of radios and television sets. Repair of high fidelity sound equipment, phonographs, and tape recorders are also included in this 1080 hour course.

4) Computer Electronics, a new course offered at Sheridan Vocational.

The beginning of this course is identical to the communications electronics. The second half, however, deals with how components are used to build digital circuitry. Fundamentals of programming, machine operation and troubleshooting are introduced. This course prepares students for employment in computer repair or digital electronic equipment repair.

Colleges

Broward Community College (BCC) offers an Associate in Science Degree as well as a certificate in Electronics Technology. The degree program prepares students for employment as technicians with skills necessary for assisting engineers in building and testing of electrical or electromechanical devices and electronic systems. BCC has an open admissions policy and does not require entrance tests. The curriculum for electronics technology includes academic courses such as mathematics, reading and composition, as well as a few physical education credits. Content courses include the following:

- 1) Electronic Drafting - lettering, electronic symbols and diagrams
- 2) DC Circuits (includes lab) - structure of matter, Ohm's law, network analysis, capacitance, magnetism, inductance, L/R time constants
- 3) AC Circuits (includes lab) - cycle, frequency, phase relations, inductance, capacitors, impedance, graphic representation of R.L.C. circuits
- 4) Technical Measurements and Calculations - use of digital and analog multimeters, methods of obtaining and presenting data
- 5) Electronic Devices I - CE, CC, CB configurations, large signals, biasing AC operation
- 6) Electronic Devices II - unijunction transistors, rectifiers, transistors
- 7) Electronic Instruments - oscilloscope, digital voltmeters, generators, power meters, frequency counters, distortion analyzers
- 8) Data Communications Fundamentals - introduction to computer hardware
- 9) Linear Circuits - properties and applications
- 10) Introduction to Computers - organization and operation of digital computers
- 11) Computers - analysis of microprocessors and microcomputers, functional operation of system components, digital test equipment

- 12) Communications I and II - resonant circuits, rectifiers, vacuum tube fundamentals, power supplies, amplifiers, oscillators, transmitters, antennas, receivers
- 13) TV Applied Circuit Analysis - study of special circuits used in TV transmitters and receivers
- 14) Digital Techniques - gating, counting, storing, shifting, converting techniques
- 15) Biomedical Instrumentation - electrocardiography, pacemakers, blood pressure measurements, cardiac output monitors, biotelemetry, X-ray, ultrasonics, electroencephalographs

The College also offers elective courses for bright and motivated students, including work experience credits and special study of advanced electronics problems.

The curriculum offers general knowledge of the electronic field and strong foundation in communication and computer electronics.

The College of Boca Raton, in conjunction with an advisory panel of executives from large electronic firms, has recently begun an electronics technician program. Due to recruitment problems involving students, this program of training has not been truly established. It does appear promising in that it has strong financial and advisory backing from local electronics industry.

Nova College, the Corporate Division, offers the following technical programs for part-time and full-time students:

- A) Certificate Program in Basic Electronics - this thirty credit program requires courses in college mathematics, digital systems, beginning programming, introduction to electronics networks, introduction to electronics theory and electronic devices, as well as electronics and electricity laboratories.
- B) Certificate Program in Advanced Electronics - this thirty credit course includes instruction in physics, Fortran, digital design, computer circuit design, engineering drawing, electronics instrumentation, theory of networks, intermediate electronic technology.

These courses appear to be geared toward students already working in the field of electronics. Students are allowed to receive credit for courses in which they can demonstrate competence.

Private Schools

Several private schools offer certificates in electronics courses, but each program appears to emphasize a different segment of the electronics industry.

- 1) Total Technical Institute
2880 N.W. 62nd Street
Ft. Lauderdale, Florida

This school offers a standard and modified computer hardware technology course which prepares students to obtain entry level employment as a computer test technician or field engineer. This school has invested a tremendous amount of money in computer equipment, and all the curriculum is geared strictly toward computer systems.

A high school diploma is required for matriculation and students must pass a written aptitude test for admission. Mr. Reichard, Vice President, estimates a student with a good math background could pass the course with an eighth grade reading level. The program consists of four semesters of 240 clock hours each for the standard course. The modified course for students with previous electronics background consists of two semesters totalling 540 hours.

Although the program is fairly new, Mr Reichard states all graduates have been placed on jobs. Most students are able to obtain part-time employment prior to completing the course of study. Overall, this appears to be a well run, professional program.

- 2) The South Florida Technical Institute
201 West Sunrise Blvd.
Ft. Lauderdale, Florida 33311

This school offers an advanced program in electronics engineering technology. This program prepares students for junior technician positions in a variety of electronics specialties, including computers, field service engineering, research and development, applications engineering, aviation and space electronics, automotive electronics, industrial electronics, microprocessor applications engineering. There is a heavy emphasis on theory with numerous mathematics and physics courses. The curriculum consists of six quarters of 300 contact hours each.

- 3) Brown Institute
 111 N. E. 44th Street
 Ft. Lauderdale, Florida 33334

This is a nationally accredited program which offers a certificate in electronics technology. This program offers a certificate which enables students to repair communications equipment, with emphasis on broadcasting, radio, television, CB radios, microwave, and marine band radio equipment. The curriculum consists of five terms, totalling 620 hours of theory instruction and 420 hours of lab instruction. Both day and evening courses are available. Applicants are given an aptitude test, the results of which are mailed to the prospective student.

- 4) United Technical Institute
 5399 N. Dixie Highway
 Ft. Lauderdale, Florida 33334

This school offers programs which prepare one for employment as a computer technician, electronics technician, test technician, or electronics assembler.

Electronics Assembler - six weeks program (180 hours)

Test Technician - 39 weeks program (720 hours)

Computer Technician - one year program (960 hours)

Electronics Technician - 91 weeks program (1680 hours)

This school is a local chapter of a national technical chain. It appears to be a well established school, with staff experienced in teaching economically disadvantaged students. The president, Vic Richards, is enthusiastic about the career ladder concept which permits students to advance according to their interest and ability to higher level technical jobs. He is willing to institute innovative programs. Mr. Richards has prior successful experience in combining academic remediation with skills training. Currently the school is involved in a Broward Employment & Training Administration (BETA) program of upgrading electronic assemblers to technicians. Their staff also works closely with local industry. Although a computer technician course is offered, the school's emphasis appears to be on communications equipment and broad general electronics background.

See Appendix I for summary of information about schools offering electronics training.

Private Industry

Input was obtained from several electronics manufacturer in order to derive a sample curriculum outline based on the career ladder concept. This sample course outline has since been mailed to large Broward County manufacturing firms for electronic equipment in order to obtain additional suggestions and revisions. The following narrative summarizes results of these initial contacts:

- 1) Burroughs Corporation
4000 Coral Ridge Drive
Coral Springs, Florida

Plants at: 2761 East Oakland Park Blvd.
Ft. Lauderdale, Florida

3050 N. 29th Court
Hollywood, Florida

Ms. Jean Shires is in charge of recruiting technicians for Burroughs Corporation, which employs over 400 people in the manufacture of electro-mechanical devices and computers. She reports they have offered jobs to graduates of BCC, UTI, and Total Tech, however, graduates of these schools have turned down the offers to accept higher paying positions at other companies. Burroughs now has successful technicians who have graduated from local schools but were employed by other companies immediately after graduation. Ms. Shires criticized some of the programs, for example Brown Institute, for not being geared toward computer systems. She also believes her company is unique due to the knowledge of analog circuitry required. The company hires assemblers, technicians and programmers.

- 2) U. I. D. Electronics (Division of AMF Enterprises)
4105 Pembroke Road
Hollywood, Florida

Rick Rubles is the new Personnel Manager for U. I. D. Electronics, which is a division of AMF Enterprises. The Hollywood branch employs 200 people in the assembly of electrical switches.

He states his company usually hires experienced assemblers who can pass a timed small parts dexterity test. U. I. D. recently participated in an upgrade program sponsored by BETA. As a result of this program 10 assemblers were sent to school to become technicians and were replaced by 10 BETA trained assemblers. Of the 10 assemblers selected for upgrading, only two were able to complete the course. He blames the high failure rate on inappropriate selection of students

with deficient academic skills. He states that he has experienced difficulty finding appropriate job placements for the two students who did complete the course. The difficulty stems from two reasons:

- A) Mr. Rubles was employed by U. I. D. after the upgrade program was already operational.
- B) The skills the students acquired in training do not match any existing job openings at U. I. D. Mr. Rubles stated U. I. D. has not experienced personnel recruitment problems except at the engineering level.

- 3) Sonar Radio Corporation
3000 Stirling Road
Ft. Lauderdale, Florida 33021

Mr. Leon Popeil is the Production Manager of Sonar Radio Corp., which employs over 100 people in the manufacture of two-way radios. Their greatest hiring needs are for wirers who have had at least three months soldering experience. His company prefers to hire individuals with previous electronics experience rather than vocational school graduates.

They do have a need for electronics technicians, but require a program which includes one year of theory in two-way radios.

- 4) ACR Electronics
2901 N. 29th Avenue
Hollywood, Florida 33020

Ms. Dania Allamania is the Personnel Manager of ACR Electronics which employs close to 200 people in the manufacture of rescue equipment. The company hires graduates of vocational schools as assemblers and well as assemblers with previous experience. All applicants must pass a soldering test in order to be hired. The company's testers and inspectors are usually promoted from within the company.

- 5) DIELCO
2775A Cypress Creek Road
Ft. Lauderdale, Florida 33309

Mr. Tony Walker is the president of this minority enterprise. He was formerly Personnel Officer for Computer Products, Inc. and Modular Computer Systems. He acknowledges that many firms hire experienced workers from competing companies. Thus skilled workers move from one company to another somewhat like

a "daisy chain," each time increasing their salaries. According to Mr. Walker, most companies recruit technicians and engineers from large schools like M. I. T. or Harvard. Unfortunately, these workers often do not stay in the South Florida area once they have to cope with the high cost of living. Mr. Walker believes that private schools, such as, U. T. I. and Total Tech, as well as Broward Community College turn out fine students; however, there are not enough graduates to meet the needs of the industry. Mr. Walker also stressed that there is an ample supply of properly trained assemblers available to local industry, but it is very difficult to locate entry level, level two and level three technicians. Those past level three technicians, commonly called super-technicians or junior engineers, require college degrees and on-the-job experience.

Other Contacts

An Electronics Upgrade Program was established in November, 1979 by the BETA Industrial Council (BIC) in cooperation with six local electronics companies and three vocational training institutions. Funding for this program comes from the Comprehensive Employment and Training Act (CETA) under Title IIC, as well as contributions received from the companies involved.

The purpose of this program is to upgrade 60 persons currently employed in low-level assembler jobs to electronics technicians within their respective companies. These 60 vacated jobs will then be filled by students trained by BETA. Firms participating in this venture are Motorola, Burroughs, Bendix, ACR, Novatronics and Harris. Training takes place at one of three institutions, each of which has a different curriculum; however, all stress basic concepts such as digital computer fundamentals, advanced electronic circuit technology, basic electronic circuits and systems, vacuum tube and semi-conductor fundamentals, as well as AC and DC circuits.

The three schools participating in this upgrade program are:

- A) School Board of Broward County, which is training 20 students for 37 weeks.
- B) Broward Community College, which is training 19 students for 40 weeks.
- C) United Technical Institute, which is training 21 students for 44 weeks.

Preliminary assessment and placement results will not be available until October, 1980.

It is hoped that the BIC will analyze and compare the data resulting from the three different training programs. Among the factors worth investigating are differential drop out rates, types of positions obtained upon completing training, supervisor and employee performance levels and job satisfaction following upgrade training, and wages after upgrading, etc. The BIC program could offer a wealth of information which could be applied to future training programs. Another valuable source of information is the success achieved in replacing the upgraded trainees with assemblers.

Discussion held with Frederick Webster, an electronics technician, and Evert Williams, a former manager at Systems Engineering Labs, Inc. (Systems) who now owns his own electronics company, revealed there is no organized union for electronics technicians or workers, and no state certified examinations. However, there are tests given by the Certified Electronic Technician's (CET) Organization to certify television repairmen. Basic courses which would train for entry level jobs in television and radio repair, as well as the tester in an electronic assembly plant, would require the ability to read schematics, use test instruments, solder, read color codes, and read resistors and capacitors.

If there is any desire for advancement, basic knowledge about theory such as Ohm's Law, Kirkoff's Law, and how resistors and capacitors work, is needed for growth and development. The need to be able to read and comprehend, as well as do math at the level of algebra, was stressed by both.

After speaking to both Dan Squires of Personnel at Systems Engineering Labs, Inc. and Gary McCoy of Training at Systems, it became evident that they hire very few people above the assembler level from any local training programs. An Associate Degree is required even for a tester or trouble-shooter, and graduates from college programs are preferred. The thrust of the training being done at Systems presently is aimed at customers and users, rather than for their own employees. Presently only 6% of their employees are involved in any advancement training. However, they are in the process of developing a series of educational programs within the company that would allow an employee to progress from entry-level jobs to junior engineers in two years of job training and education.

The availability of assemblers is good and they are hired after graduation from local schools. There are few trained workers available to fill the jobs requiring the skills of a tester or technician, and the workers hired are difficult to keep on the job. However, needs at Systems are very specialized and they prefer to train people themselves after the prospective employee has obtained an Associate Degree in electronics.

Gary McCoy feels that it is imperative that anyone who wishes to progress beyond an assembler must have a high reading level, an understanding of formal math, and a basic understanding of physics. The ability to read and comprehend large amounts of technical materials quickly is very important.

Field Visits Conclusions

After compiling the information gathered from all the visits to electronics firms, several points became clear, and were found to be common to most companies in the field.

Although all of the companies agree that the opportunity for advancement should exist for all employees, most do not provide the training necessary, nor do they rehire employees in better jobs after receiving training.

None of the companies is happy with the vocational schools or programs that exist, and they all stress that they have special training needs that are not being met. Most state that much of the present vocational training is outdated and ineffective. All companies seem to prefer some sort of hands-on training for employees at the work site, and prefer to recruit from degree oriented programs outside the county or state rather than local programs. All of the companies expressed doubt that the local schools and programs would be able to meet their needs, even with changes in the programs; and they also believe that those who have dropped out of school for academic reasons would not have the reading and math skills to enable them to master technical material and to advance up a career ladder.

Recommendations for the Vocational Academy - Career Ladders

As a result of a search of the literature and field visits, a sample training career ladder for the electronics industry has been compiled by the research assistants of the Vocational Academy. The career ladder in Appendix II is proposed as a model and is but one of many which could be derived from the electronics field.

This particular model is being proposed for implementation as it covers a broad range of employment opportunities and can be adapted to an economically disadvantaged population. The possibility of a career ladder for the field of repair and servicing of electronic communications equipment was considered. This was rejected due to the seasonal and unstable character of the work. The computer field is also a rapidly growing field which could conceivably generate a specialized career ladder instead of being incorporated into our concept.

The problems of developing a career ladder suitable for Broward County needs were complicated by the unique problems of

local firms. Most companies contacted viewed themselves as having unique and specialized training needs. The career ladder suggested in Appendix II is a compromise to meet the varied needs of the firms contacted thus far.

Curriculum

Several problems exist with the present curricula found in the vocational education electronics programs in Broward County. The different courses available are spread around in several different schools. There is no centralized area for the schools, and none of the schools is located near the electronics companies in Broward County. If a student wishes to begin in the assembler course and progress through an Associate Degree in electronics technology, at least three school changes would be required ranging from B. F. James Adult Center or Atlantic Vocational School to Sheridan Vocational School, and finally to Broward Community College.

All of the courses taught, particularly those offered by the School Board in its three sites, are considered out-of-date and contain material that is not relevant to the job for which the student is preparing. The electronic assembler course offered by the School Board requires instructors to teach wire-wrapping and does not address the use of quick-tie--a process requiring the worker to merely slip a wire through a loop and pull down a sleeve rather than wrapping a wire around a connection and soldering.

In spite of the fact that these courses are designed to teach job skills to people who have not been successful in traditional education, all of the classes continue to use a conventional form of teaching, with lectures by the instructor and reading assignments to present the material. Further, most upgrading of basic skills is handled by referring students to Adult Basic Education (ABE) classes taught in traditional ways.

The local vocational schools, whether public or private, are not meeting the needs of the local industries. This is evident by the complaints of personnel managers; the low hiring rate of local people by industry, and the high rate of job turnover and job change after training.

Many changes are being proposed, both in the actual material taught, and in the method of teaching and presenting material. Changes in the curriculum being taught will include the exclusion of irrelevant or out-of-date material.

Development of the Curriculum

A preliminary curriculum developed by the researchers was compiled from a variety of sources in Broward County, Florida and other areas of the country. Initially letters were sent to Project Cooperation in Salt Lake City, Utah and to the State of Alabama Skills Training Center in Montgomery, Alabama requesting information on their curricula in the electronics field. Field visits were made by the staff of the Vocational Academy to local vocational schools - Total Technical Institute and United Technical Institute, to the School Board facilities at Sheridan Vocational School, Atlantic Vocational School and B. F. James Vocational School, and the electronics programs at Broward Community College and Nova University.

After careful review of the above programs, the Vocational Academy preliminary curriculum for three levels of electronics instruction was designed. Level I provides instruction in Electronics Assembly, Level IIA in Electronics Tester or Troubleshooter, Level IIB in Computer Bench Worker and Level III in Junior Technician. The courses for Electronics Assembly and Junior Technician provide instruction in both areas of electronics - communication, which uses analog circuitry, and computers, which employ digital circuitry.

Analog circuitry uses solid or stranded copper wire with a potential of 12 to 20 volts, and requires the tester to have an understanding of electronics theory to repair equipment. Digital circuitry uses printed circuits on boards with a potential of less than ten volts, and requires the bench worker to understand the functions of the equipment and the schematic diagrams for the equipment to perform maintenance and repairs.

Level II was divided into two parallel courses, one in electronics communication, the other in computers. Each course is designed to prepare students to test equipment, and find and repair problems. This dichotomy was considered necessary because of differences in required training between these two areas. Understanding electronics principles such as amplification, oscillation and modulation is necessary to repair communication equipment, but not computer equipment. The ability to repair computers requires an understanding of binary arithmetic, Boolean algebra, logic, and other concepts related to digital function and design.

The preliminary curriculum was developed by the Research Assistants of the Vocational Academy and included all curriculum items taught at each level in all the vocational schools contacted. It was anticipated that there were items included in each level of the curriculum that were not needed to prepare students for

jobs in Broward County electronics firms, and that some needed curriculum items had not been included. Electronics firms in Broward County were asked to indicate which items in the curriculum were superfluous to their needs and to suggest relevant omitted items. In this way the proposed preliminary Vocational Academy curriculum could be refined to meet the specific needs of local electronics firms; and, at the same time, provide a vehicle for input from the private sector, an objective of the Vocational Academy.

The preliminary curriculum was mailed to 26 electronics firms and one vocational school in Broward County. (See Appendix VIII for complete listing.) The firms contacted ranged from small privately owned firms to large publicly held firms with branches in several states. Two weeks were allowed for the curriculum forms to be reviewed and written responses returned by the electronics firms. All firms not responding in the time allowed were contacted by telephone; the importance of the curriculum was explained; and they were asked again to review the curriculum and to return the form by mail.

During the first two weeks, seven electronics firms returned the curriculum outlines. Six of the returned forms had been revised and contained suggestions for improvement, and one form was returned without comment. The reason given for the absence of comment was that the particular firm only manufactured unfinished printed boards, and the curriculum was not applicable to them. After repeated telephone calls to electronics firms, additional response was obtained. Two additional reviews of the Vocational Academy curriculum were obtained by the researcher from personal contacts with owners of small electronics firms not appearing on the original mailing list.

After one month a total of 10 curriculum forms had been returned, with nine of the 10 critiqued by principals of electronics firms. (See Appendix IX for list.) This represented a 34.5% return, a representative sample in research.

Reasons given by representatives of electronics firms for failure to return the critiqued curriculum forms were many and varied. One plant had been closed and operations moved to Orlando; another had changed ownership; and a third had its telephone disconnected. Twelve contacts promised to relay messages to the responsible person in the firm or to return the researcher's calls. Only one of these telephone calls was returned by the manager of an electronics firm to the researcher. Two firms felt the curriculum did not apply to their businesses, one did not have time to read the curriculum and to reply; and one manager asked for a second curriculum to be mailed to his office in another branch of his firm. The

second curriculum was mailed by the researcher and follow-up showed that it was received by the manager; however, it was never returned, even though four follow-up phone calls and visits were made by the researcher.

Overview of Responses from Electronics Firms

Level I - Electronics Assembler

Appendix V is a copy of the curriculum mailed to the electronics firms, and the item numbers referred to below correspond to the items on this curriculum.

All electronics firms responding indicated that Item One, Orientation to Electronics, should be included and no changes were suggested.

Item Two, Basic Electronics Principles, was approved by seven firms and rejected by two. One of those rejecting the item felt that it was not needed before the Inspector or Tester Level. It was stated that all an assembler needs to know is "will it shock me?" One firm requested the addition of basic electronics math concepts, and another suggested including Ohm's Law and the principles involved in working with voltage.

Item Three, Tools for Electronics Assembly, was approved by all nine responding firms with only one suggested addition: maintenance of and responsibility for tools. The addition of an Item, Mechanical Assembly, was suggested at this point by two firms. This item includes nuts and bolts assembly and techniques of torque adjustment.

All nine firms felt that Item Four, Soldering, was very important and should be a major emphasis in the course. Two suggested additions to this item were the use of heat shrink tubing and desoldering and solder repair techniques. The ability to desolder and repair boards is important because the parts on a small board may be worth up to \$50.00 and it is not economical for companies to dispose of nonfunctioning boards. Multilayer board repair is a technique new to the industry, and one training instructor indicated that it would be a worthwhile addition.

All electronics firms responding indicated that Item Five, Harness Fabrication, should be included and no changes were suggested.

Item Six, Wire Wrapping, was expected to be eliminated from the curriculum by most firms in favor of quick-tie. However, only two responding firms suggested exclusion of this item, and seven stated that this process was used in their businesses.

Before Item Seven, one new Item addition was recommended by two electronics firms. It was felt that Component Recognition and Component Functions were necessary instruction items for proper assembly of printed circuit boards. Most components have a positive and negative end and can only be placed in one alignment in a board. Components identified and described under this item should include resistors, capacitors, transistors, diodes and triodes.

All electronics firms approved both Item Seven, Printed Circuit Boards, and Item Eight, Color Coding. The addition of two steps was suggested in Item Seven, mounting triodes and mounting transistors.

Item Nine, Pictorial Diagrams, was approved by only six of the nine responding firms. The other three stated that they employed the use of assembly method sheets or assembly drawings for the assemblers to follow rather than schematics, and felt that the reading of assembly drawings should be taught in the place of reading schematics.

Item Ten, Work Orientation, was enthusiastically approved by all nine electronics firms, but all felt that this should be a continuing emphasis throughout the course, rather than a distinct item taught at the end. (The Vocational Academy had planned to have Work Orientation at the beginning and throughout training). One firm suggested the addition of the issue of quality and quantity as a necessary aspect taught under this item. Employers stressed the need for quality production in the work done by employees, because the cost of one printed circuit board can be more than \$50.00. It is difficult to remove and replace improperly inserted components, and nonfunctioning boards must be discarded at a loss to the company. However, employees are also required to work quickly and produce a quota of boards each day. Therefore, they must balance their ability to work quickly (quantity) with their ability to work accurately (quality).

All 10 items were approved by the majority of responding electronics firms, with the largest difference being six approvals and three rejections for Item Nine, Pictorial Diagrams. The researcher recommends that no Items be dropped from the curriculum, but that the suggested additions be incorporated into it to make the course responsive to the needs of as many local electronics firms as possible. Because assemblers do not use math in their jobs, it was decided that the basic electronics math skills be taught at the Tester level, rather than at this basic entry level. This is especially important for those students who have not finished high school and are attending basic skills workshops in math and reading. Wire wrapping should remain in the curriculum because it is used by many area businesses. However, since quick-tie is also

used in some firms, it is suggested that it also be included. The researcher agrees with the electronics firms that Work Orientation should be an integral part of the entire course, rather than being taught as a separate unit. Simple changes such as assigning each student his own tools and holding him responsible for their damage or loss can be part of this unit.

Table One below outlines the proposed final curriculum for Level I - Electronics Assembler, with the suggested number of classroom hours for each item appearing at the right. A total of 180 classroom hours, taught in 30 hour weeks, creates a six week long course to train students to be Electronics Assemblers.

Table One
Level I - Electronics Assembler

	Classroom Hours
I. Orientation to Electronics	
A. Occupational outlook for electronics	3
B. Electronics as a career	
C. The career ladder concept	
II. Basic Electronics Principles	15
A. Ohm's Law	
B. Principles of voltage	
C. Current	
D. Resistance	
E. Insulators	
III. Tools for Electronic Assembly	10
A. Soldering iron	
B. Soldering aid	
C. Pliers	

Table One Continued

D. Wire strippers	24
E. Screw drivers	
F. Wrenches	
G. Selection of tools	
H. Maintenance of and responsibility for tools	
I. Safety procedures	
IV. Mechanical Assembly	5
A. Nuts and bolts assembly	
B. Techniques of torque adjustment	
V. Soldering	30
A. Introduction to soldering	
B. Contour soldering technique	
C. Use of sponge and cleaning solvents	
D. Nature of solder	
E. Types of solder	
F. Use of flux	
G. Soldering printed circuits	
H. Dip soldering	
I. Wave soldering	
J. Soldering two connections	
K. Soldering three connections	
L. Desoldering techniques	
M. Solder repair and multilayer board repair	
N. Use of heat shrink tubing	
VI. Harness Fabrication	10
VII. Wire wrapping	5
A. Quick tie	
VIII. Component Recognition and Component Functions	10
A. Resistors	
B. Capacitors	
C. Transistors	
D. Diodes	
E. Triodes	
IX. Printed Circuit Boards	20
A. Introduction	
B. Mounting components	
C. Mounting transistors	
D. Mounting diodes	
E. Mounting triodes	
F. Mounting integrated circuits	
G. Stress bends on components	
X. Color Coding	25
A. Introduction	
B. Purpose	
C. Example	
D. Practice in reading resistors according to color codes	

	25
XI. Pictorial Diagrams	22
A. Assembly method sheet	
B. Assembly drawings	
C. Purpose of schematics	
D. How to read schematics	
E. Uses in industry	
XII. Work Orientation	25
(Not a separate unit, but incorporated into every class session.)	
A. Interpersonal relationships with supervisors	
1. Accepting role	
2. Asking questions	
3. Work rules	
B. Employer expectations	
1. Use of equipment	
2. Confidentiality	
3. Attendance	
4. Punctuality	
5. Grooming	
6. Relationships with co-workers	
7. Quality and quantity	

180

Level IIA - Electronics Tester or Trouble-Shooter

Because the second level of instruction has been divided into preparation for communication and computer electronics, response from the electronics firms was more detailed on either Level IIA or Level IIB. Two firms that critiqued the curriculum manufacture computer products, and felt that Level IIA, which provides instruction in communication electronics, did not apply to their needs. Seven firms responding manufacture electronics components other than computers, and suggested revisions for the Electronics Tester curriculum.

All seven firms critiquing this level indicated that Item One, Basic Concepts, should be included. Suggested additions to this Item included basic electronics math concepts and conversion of measurement units. Solving problems related to Ohm's Law and converting watts to kilowatts are typical problems a tester must solve.

One personnel manager stated that there should be a skill level between the assembler and the tester, typically called an inspector. The electronics inspector usually has received more education than an assembler, but is not able to repair

electronics equipment. The task of an inspector on an assembly line consists of sorting printed circuit boards according to whether or not they function properly, although the inspector may not be able to find the reason for the malfunction. There are job openings available for workers with the skills necessary to be inspectors. After completing Item One of Level IIA, personnel managers felt that students should be able to exit the program when certified as Electronics Inspectors.

Item Two, Electron Tubes, was rejected by all but two firms. Electron tubes are used very little in the local industry, and need not be included in a curriculum. One general manager indicated that instruction in transistor principles would make it easy for any tester to understand and use electron tubes if necessary, while it would be very difficult to reverse the process and learn about electron tubes and then try to understand transistors later.

The next four items on the curriculum (Item Three, Transistor Principles; Item Four, Circuits for Voltage and Current Distribution; Item Five, Circuit Description; Item Six, Power Supplies) were included by all electronics firms. The only addition suggested was the inclusion of basic filters, both high pass and low pass, to Item Five.

The next three Items on the curriculum (Item Seven, Low Frequency Amplifiers; Item Eight, High Frequency Amplifiers; Item Nine, Oscillators and Frequency Converters) were rejected by both firms manufacturing computers, but were included as needed by all seven general electronics firms.

Item Ten, Modulation, and Item Eleven, Receivers, were included in the curriculum by six of the seven electronics firms producing components other than computers, and rejected as unnecessary by one. Both computer firms felt these were inapplicable to their needs.

One employer suggested inclusion in the curriculum at the Tester level of a module on the use of an electronics library to find needed information. Because new techniques are being developed and knowledge added to the field every day, it is necessary for employees to have access to this information.

The curriculum for Electronics Tester or Trouble-Shooter was accepted by all of the electronics firms producing components other than computers, with few changes other than the deletion of instruction on electron tubes. The major change was the suggestion to provide another exit point from the course after Item One, Basic Concepts, with the student being certified as an Inspector. This allows for a shorter period of training,

and allows students to leave the curriculum who experience difficulty with electronics theory, while still allowing them to obtain a job higher on the career ladder than electronics assembler.

Table Two below outlines the proposed final curriculum for Level IIA - Electronics Tester or Trouble-Shooter, with the number of classroom hours for each Item appearing at the right. A total of 780 classroom hours taught in 30 hour weeks creates a 26 week long course. When this course is taken following the course in Electronics Assembly, it would provide a total of 960 classroom hours, or 32 weeks.

Table Two
Electronics Tester or Trouble Shooter
Level IIA - Communications

	Classroom Hours
I. Basic Concepts	270
A. Electrical terminology	
B. Units of measurement and conversions of units	
C. Fundamentals of magnetism	
D. Ohm's Law	
E. D.C. power and circuits	
F. Resistance	
G. Inductance	
H. Capacitance	
I. Basic math concepts	
**Exit point from the program with certification as Electronics Inspector. A total of 270 classroom hours taught in 30 hour weeks creates a nine week long course. When this is combined with the course in Electronics Assembly, it provides a total of 350 classroom hour or 15 weeks.	
II. Transistor Principles	70
A. Semiconductor theory	
B. Symbols	
C. Basic transistor circuits	
III. Circuits for Voltage and Current Distribution	40
A. Voltage dividers	
B. Series circuits	
C. Parallel circuits	

	28
IV. Circuit Description	105
A. Rectification	
B. Amplification	
C. Oscillation	
D. Basic filters - high pass and low pass	
V. Power Supplies	60
A. Function	
B. Types	
C. Identification	
D. Filtering	
VI. Low Frequency Amplifiers	60
A. Types	
B. Application	
C. Function	
D. Loudspeakers	
E. Circuit description	
F. Testing procedures	
VII. High Frequency Amplifiers	60
A. Selectivity	
B. Tuned circuits	
C. Resonance	
D. Testing procedures	
VIII. Oscillators and Frequency Converters	25
A. Regeneration	
B. Circuit description	
C. Frequency mixing	
D. Tracking	
IX. Modulation	20
A. Purposes	
B. Types	
C. Demodulation	
D. Automatic volume control	
X. Receivers	60
A. Superheterodyne circuitry	
B. Troubleshooting techniques	
XI. Use of Electronics Library	10

	780

Level IIB - Bench Worker

This level of the curriculum provides instruction in computer electronics, intended to teach students to isolate problems and effect repairs on computers. Although only two of the nine electronics firms that evaluated the preliminary curriculum produce computers, seven of the nine firms critiqued this level of the curriculum. Two of the nine firms stated that this part of the program was not applicable to their needs and rejected all Items in it.

An important point made by the owner of one electronics firm and by Wallace Elliot, Curriculum Supervisor of the Vocational, Technical and Adult Education, Broward County School Board, was the misleading aspect of the title of this course. Both felt that a bench worker was similar to an inspector in communications and required less education than provided in this curriculum. A name suggested for this section (bench worker) of the curriculum that seemed more appropriate to the amount of education the student would receive was "digital tester." The name digital tester discriminates between the training in this level and Level IIA, indicating that it is computer oriented, and is more representative of the amount of training the student would receive.

All five Items in this curriculum were approved by the seven firms responding with minor suggestions for change. Suggested inclusions in Item One, Introduction to Computers, were binary arithmetic and truth tables. It is necessary to understand binary arithmetic, based on digits of zero and one rather than zero through nine, in order to learn Boolean algebra, which is based on binary arithmetic. Hexadecimal coding is also a necessary inclusion to prepare the student to understand the address system used to locate memory sites on electronic memory chips.

Item Two, Basic Concepts, is part of the curriculum in both Level IIA and Level IIB. It was suggested by one employer that unit conversions be added here also. However, it is not necessary to include basic electronics math concepts in this unit because binary arithmetic and Boolean algebra, more appropriate to computers, are included in Item One.

Item Three, Circuit Description, is part of both Level IIA and Level IIB curriculum, and the only suggested change here, as in Level IIA, is the inclusion of basic high and low pass filters.

Item Four, Digital Computer Operation and Control, was approved, but both computer firms suggested that this section

of the course should be based on Read Only Memory (ROM) and Random Access Memory (RAM) rather than core memory. ROM and RAM memory bases are found in most computers today, and are based on small electronic chips used to store information. Core memory is not used in many computers today except some large computers, and is based on a magnetic ring for memory storage. The computers manufactured by the two computer firms responding to our curriculum use ROM and RAM memory bases.

Several suggestions for additions to the curriculum in Level IIB were made by the two computer firms. Three of these suggested additions (digital instruction, gates, and logic analysis) are already included in the present curriculum in Item One. Important items needed for the understanding of computers that should be added are flip flops, semiconductors, microprocessing, power supplies, central processing unit (CPU) theory, addresses, and system level instruction on printed circuit boards with resident components. Microprocessing should be included in Item One as part of the introduction to computers and their functions. System level instruction with printed circuit boards should be included as a separate item following Item Two, Basic Concepts. The study of semiconductors and flip flops, switches with on-off positions representing zero and one in binary arithmetic, should be included in Item Three, Circuit Description. CPU theory and types of power supplies are most appropriately included in Item Four, Digital Computer Operation and Control. Addresses, the locators for memory components on electronic memory chips, should be included in Item Five, Digital Computer Operation and Control.

The researcher feels that it would be advantageous to the student to include use of electronics libraries in this level also. New information and techniques are developed even more rapidly in the computer field than in the communication field, and employees should know how to find needed information.

Table Three below outlines the proposed final curriculum for Level IIB - Bench Worker. However, it will now be referred to as Digital Tester. The number of classroom hours appear at the right of each Item in the curriculum. A total of 1020 classroom hours taught in 30 hour weeks creates a 34 week long course. When this course is taken following the course in Electronics Assembly, it would provide a total of 1200 classroom hours, or 40 weeks.

Table Three
Digital Tester
Level IIB - Computers

	Classroom Hours
I. Introduction to Computers	200
A. Number systems	
B. Logic symbols, truth tables, binary arithmetic, Boolean algebra, hexadecimal coding, gate networks	
C. Logical designs and circuits	
D. Digital control and measuring devices	
E. Microprocessing	
II. Basic Concepts	240
A. Electronics terminology	
B. Units of measurement and conversions of units	
C. Fundamentals of magnetism	
D. Ohm's Law	
E. D.C. power and circuits	
F. Resistance	
G. Inductance	
H. Capacitance	
III. System Level Instruction	60
A. Printed circuit board with resident components	
IV. Circuit Description	120
A. Rectification	
B. Amplification	
C. Oscillation	
D. Basic filters - high pass and low pass	
E. Semiconductors	
F. Flip flops	
V. Digital Computer Operation and Control	270
(ROM and RAM, not core)	
A. Addresses	
B. Memory systems	
C. Types of input	
D. Types of output	
E. Operating procedures	
F. CPU theory	
G. Power supplies	
VI. Troubleshooting	200
A. Basic procedure	
B. Power supply tests	
C. Problems in data transfer	
D. Memory malfunction	
E. Adder and adder control malfunctions	
F. Diagnostic programs	
VII. Use of Electronics Library	10

Level III - Junior Technician

It was determined by the electronics firms and the researchers that Level II requires education in a Junior College or degree oriented setting, and is not appropriate to a vocational school. It requires a high reading level and an excellent understanding of math concepts, and students who have not graduated from high school would not be able to succeed without prior study and preparation. The Vocational Academy has not evaluated or developed the curriculum for Level III since its target population has limited formal education and must meet CETA eligibility requirements.

Teaching Approach

Many changes need to be made in the teaching approach that will be used. Because the majority of the CETA population of students is one that has already failed for one reason or another with a traditional education approach, the program must look to alternative education and take its example from the special education leaders. Special education is expert at teaching those who cannot learn in a traditional manner, and has developed an individualized approach that allows students to proceed at their own pace and progress in very small units. These small units consist of single pieces of information or simple skills that can later be continued to accomplish a more difficult task. Information is provided in several ways: oral, visual, and kinetic; and, at the same time, the student can repeat the learning process until he or she understands and can perform the task. Material is presented in small units called Learning Activity Packages (LAPs) which are self-contained units of instruction including teaching, practice, and evaluation, all covered by the students on their own. The instructor or instructors are then free to work individually with those students who need help and guidance. As students finish each LAP, they are evaluated, and those who show mastery of the tasks receive certificates of accomplishment. Students will be encouraged to aid those who are working on earlier LAPs. Besides helping others, the peer teacher will enhance his or her own feelings of worth and accomplishment and further reinforce and add to the knowledge acquired.

Because the course is structured so that students' progress individually, students may be entering and leaving on a continual basis. This would require scheduling when the equipment normally would not be used, thereby, ensuring the most economical use of the building and equipment. Although it would require the addition of audio-visual equipment to present the material in the LAPs, there would be need for less electronic equipment because there would be students working at different levels. The course would not require multiple pieces of equipment for every student in the class. The instructor's time would be freed

to work with each student individually as required, rather than preparing and presenting lectures. The lecture material would be presented to the students on tapes, filmstrips and films in the LAPs.

Because these students have often not completed their high school education, they may be deficient in both reading and math skills, both of which are extremely important in electronics classes above the assembler level. Several innovative methods have been used by educators to remediate these skills. The traditional two methods of remediating and evaluating are accomplished by sending students back for ABE or having them take and pass a high school graduate level competency examination for General Equivalency Diploma (GED).

The United Technical Institute (U. T. I.) attempted to provide training in basic skills for students in order to increase the number of applicants that could be accepted into the program. Students attended the standard electronics class for four to six hours each day, and those who needed remedial work took the material they were using in the electronics class and used it to improve their basic skills under the direction of a special teacher familiar with electronics, math and reading. Although this enabled U. T. I. to successfully graduate these students, the program was discontinued because it cut into the profits of the school.

The Manpower Training Center (MTC) of the Broward County School Board operates a program called Individualized Manpower Training Systems (IMT), which requires students to attend a course for six hours a day, five days a week for as long as needed to upgrade basic skills, learn job vocabulary, and learn work habits and attitudes. When the student has advanced enough, he is allowed to proceed to job skills training. Although IMTS looks effective, it rarely occurs or is followed in actual practice by MTC.

A program at BCC exists in the Learning Resources Center, which is the skills building areas for all students having problems. Instructors refer students to the Center where an individual program of skills improvement is prescribed based on their abilities and the training program in which they are enrolled.

The Vocational Academy must provide similar training to students in basic skills. The basic skills education should be similar to the program used at U. T. I., with an instructor trained in special education in reading and math who is also familiar with the electronics curriculum. Students could use the basic skills as special help for individual problems, or for a detailed program aimed at greatly increasing basic skills.

The program would always be based on the electronics curriculum and would be relevant to the job for which they were preparing.

Location of the Vocational Academy is important for its success both with the students and with local industry. The Academy should be located near local electronics industries, giving students access to the industries, and the industries more assurance that the school is there to serve them. All classes should be located at one site rather than spread out in several different areas or building.

It is important that the local industries have as much input into the program at as early a stage as possible. This has been attempted with the mailing of 27 curriculum outlines to electronics companies by the staff of the Vocational Academy. It is recommended that this linkage relationship be pursued by establishing an industrial council to serve as an active advisory board and liaison between the training institution and electronics industries.

Students need to be evaluated on a continuing basis, rather than being tested or receiving a grade at the end of a course. Part of each LAP is a demonstration of mastery of the skill being taught; and after a demonstration of mastery, the student receives a certificate stating that s/he has finished the LAP. Further demonstration of mastery occurs when peer teachers are able to assist other students in learning LAPs which they have mastered. All evaluation techniques used in the course would be based on demonstrations of ability to perform job-related tasks rather than paper and pencil tests. A student would be asked to choose the proper solder and correctly solder connections, rather than being asked multiple choice questions about solder and which kinds should be used. Because each individual skill learned is evaluated and a certificate is issued for mastery of the course, the student's motivation would remain high throughout the course. The employer would also have a better understanding of what the student is able to do.

Sample Learning Activity Package #1 - Soldering (Tinning Process):Objectives:

The student must be able to:

1. Discuss the hazards of improper tinning
2. Properly heat and tin a soldering iron

Materials:

Soldering irons in new, pitted, and tinned conditions
Pictures of tinned, untinned and pitted irons
Filmstrip with tape on tinning irons
Set of cards containing detailed instructions on tinning
Solder
Clean Rag
Vise
File

Outline:

1. View filmstrip with tape that discusses the importance of tinning a soldering iron and how it is done.
2. Student views pictures of untinned new iron, properly tinned iron and pitted iron; matching them with examples in his kit.
3. Student attempts to tin an iron by following series of detailed steps placed on plasticized cards with illustrations. (Note: Step may be repeated as many times as needed.)

Evaluation:

Student demonstrates his ability to tin an iron by properly tinning a new and a pitted iron.

Sample Learning Activity Package #2 - Ohm's Law:Definition:

Ohm's Law is an equation written in the form $R = V/I$.
R is the amount of resistance in the circuit, expressed in ohms, and is directly related to the voltage (V) expressed in volts and inversely related to the current (I) expressed in amperes. One ohm of resistance is found in a circuit with one ampere of current flowing with a pressure of one volt. (Industrial Reading Test, Form B, 1977)

Objectives:

The student must be able to:

1. Write down the formula for Ohm's Law and compute current flow, resistance, or voltage.
2. Distinguish between voltage, resistance, and current.

Materials:

Tape on Ohm's Law
Set of descriptive cards on current, resistance, voltage
Set of problem cards for practice
Set of example cards with sample computations
Write-up to keep on Ohm's Law with short answer questions at the end (with included answer sheet).

Outline:

1. Student listens to tape about Ohm's Law.
2. Student reads written material on Ohm's Law, takes notes, and attempts to answer questions. If questions are answered incorrectly, material must be reviewed.
3. With the use of sample computation cards, student calculates current flow, resistance, and voltage using Ohm's Law and the problems given.
4. Student matches up descriptions or definitions with proper names and proper symbols.

Evaluation:

1. Student identifies and defines for instructor proper names and symbols for current, resistance, and voltage.
2. Student calculates properly the current, resistance, and voltage, using Ohm's Law.

Orientation to the World of Work - Electronics

In this decade, there is a need for greater flexibility in the field of vocational education, yet the literature reflects a rigidity of thinking, a dogmatic approach to vocational education. Perhaps this is a result of the fast-paced world in which we live. Yet, paradoxically, because we are becoming so advanced technologically, we need flexible vocational education programs.

There are, however, some researchers who are able to do more than lament over the current state of affairs. Leighbody (1972) states that vocational educators typically believe that their task begins only after an orientation to the world-of-work has taken place. However, he believes that such an orientation should actually be a part of the vocational education process itself.

Leighbody cites two major reasons to support his belief. The first is that it is increasingly more difficult to become oriented to the world-of-work at an early age. In times past, work was observed quite frequently as it was a daily part of family life. However, today many jobs are performed in locations such as factories or offices and the opportunity to observe a variety of occupations is thus decreased.

Some educators in response to this problem suggest an orientation to the world-of-work during the grammar school years; however, Leighbody counters by saying that the teacher often has a limited knowledge of the subject matter and as a result nothing much is gained.

There are a number of problems due to the lack of work orientation. Hansen (1977) lists several societal trends leading to the increased number of women who choose a career today. She goes on to say that the early programming of sex roles during adolescence is still occurring. One result is that women are still filling traditional work positions. Out of 23,000 occupations listed in the Dictionary of Occupational Titles (DOT), two-thirds of all women workers fall into only 27 occupations.

As was already mentioned, Hansen attributes part of this to sex role indoctrination. In addition, she cites a lack of work orientation as a major factor leading to such narrow occupational choices.

With the need for an orientation to the world-of-work emphasized, we need to address the specific skills a vocational counselor must have. In this discussion the term "Counselor" is broadened to include all staff people who work with students during the orientation period.

Morrill and Forrest (1977) present the case for multiple levels of vocational counseling. They propose the following four levels of counseling: Level 1 aids the client with a specific career decision by providing information. The second level aids the client with a specific career decision, yet the emphasis is on decision making skills. In the third level, the career is viewed as a process not a static end. On this level then, counseling changes from a focus on the correct career choice to a continual series of choices. The fourth level focuses on the creative potential of the individual to achieve his/her objectives.

The benefits of such a counseling approach, according to the authors, is that personal counseling and vocational counseling are not compartmentalized but rather the two types merge to form an optimal kind of counseling.

Arredondo-Dowd and Gonsalves (1980) make the case for training more culturally effective counselors. Sue (1978) defines the culturally effective counselor as one who understands his/her own values and recognizes that other peoples' values may be different. In addition, the culturally effective counselor respects individual differences and is aware of the sociopolitical forces that may have shaped culturally different groups. Arredondo-Dowd and Gonsalves say that counselors need up-to-date knowledge and skills to supplant misconceptions about multicultural populations.

The Need for Orientation in Broward County

The research assistant visited the Broward Industrial Board and met with Chris Morris, an employee of the Broward Employment and Training Administration (BETA). Because of her position she is familiar with some of the complaints from electronics industries about BETA students, especially those who have become electro-mechanical assemblers. Some employers' complaints include non-compliance with dress codes, tardiness, absenteeism, and the use of drugs and alcohol on company time.

Mrs. Morris' conceptualization of the problem is genuine. Although not attributing work problems of trainees to cultural differences, which in the opinion of the researcher could be explored to the benefit of any multicultural group, she attributes them to a counter-productive home environment.

The research assistant next visited Vic Richards of United Technical Institute. While Mr. Richards seemed quite concerned about some of the problems of the beginning worker, he seemed quite definite about potential solutions. He believes that young BETA students have a poor self-concept. Mr. Richards suggested a form of attitude adjustment and specifically mentioned Earl Nightengale, Dale Carnegie and Norman Vincent Peale. One

of his suggestions which, in the opinion of the researcher, had some genuine merit was to see a new, measurable skill taught each day so that students will learn that they can achieve.

Jerry Yesbeck, intake coordinator for BETA, was the next person consulted. Mr. Yesbeck was very quick to defend BETA programs and their practices. He claims that BETA employees are doing all they can given their constraints for their clients. However, he did have some suggestions for change. Mr. Yesbeck would like to see a Career Planning Workshop, which would be broken down into two basic components as follows:

The first component would include decision making skills, an understanding that one has choices to make in one's life, an aptitude assessment and a look at the past in terms of its influence on the present and future. In the second component, Mr. Yesbeck would like to see emphasis on job-seeking and job-keeping skills. In the latter, the following social skills would be included: How to present oneself at a potential employer's office; how to do well in the interview; and how to resolve conflicts with fellow employees.

When asked about the situations in which BETA clients receive more money during training than is available on the current job market (dissuading some from seeking employment). Mr. Yesbeck called this situation, "dismal." He sees the solution as persuading electronics firms to pay more than minimum wages.

Finally, he praised BETA programs by saying that overall, not only in electronics, BETA has a 65% placement rate.

Orientation to the World-of-Work: A Proposal

Upon establishing a clear need for an orientation to the world-of-work program, the research assistant was assigned the task of designing such an orientation. The following two-phase design is proposed: The first phase would be a one-time event, including an introduction to the training institution's staff and programs as well as a brief orientation to the world-of-work. A flexible outline for such a presentation might look like this:

- 1) Introduction of the trainer and trainees in the group through an "ice breaking" technique, which is of particular importance since this same group will be working together for some time. The immediate effect of the "warm-up" exercise is to give the student a sense of belonging to the group

and to make the situation he is in more cohesive.

- 2) Utilize the services of an orientation coordinator of the same ethnic origin as the majority of the members of the particular group being introduced at the training institution. This would provide the trainees with a role model and would help the group to identify with the leader. A subtle effect of this could be a greater opportunity for "modeling" to occur, which would facilitate the adoption of attitudes and beliefs about the objectives of the training institution and the world-of-work.
- 3) Introduce the training institution through an historical approach, using a film or slide format. Include in this history a statement of the purpose of the training institution and what the project can do for the students.
- 4) Present a brief history of the field of electronics as a growth industry needing local personnel. This explanation may be followed by a presentation of how the development of the microchip has enhanced employment in the field of electronics.
- 5) Discuss the mechanics of the world-of-work, including a discussion of wages, time-cards, fringe benefits, social security, how to read a paycheck, attendance and promptness. Stress promptly clocking in and out of work, and what to do about forgetting to "punch" the clock.
- 6) Discuss the personal grooming habits necessary for job procurement and job-continuance. Topics covered will be the importance of wearing appropriate clothing, dress codes, safety regulations, etc.
- 7) Present either live or by videotape a successful minority person who has excelled in the field of electronics. The theme of this autobiographical presentation would be to motivate the students by providing a successful role model.

Phase II

The objectives of this orientation phase were suggested on the advice of local resources visited by the research assistant, and should continue throughout the students' training.

This phase focuses on some of the points covered in Phase I; however, some points are to be covered in depth in Phase II, along with new areas. The manual for potential students will describe such aspects of the world-of-work as

understanding the benefits of social security, grooming for the interview, preparing a resume, conduct during the interview, and other job-seeking and job holding skills.

In the Level I manual for beginning workers (See Appendix), there are six topics, one for each week of training in the electro-mechanical assembler's curriculum, covering some of the materials discussed above.

The manual for Level II should focus more on verbal than on written communication skills, and should also include human relations.

Summary

Training of vocational students under the proposed orientation program would prepare them well for the real world-of-work. In fact, because many local industries have not yet accepted community based training programs, the approach of the training institution could be instrumental in gaining their acceptance and cooperation. Industries must be convinced that students coming from alternative training programs such as the alternative model recommended by the Vocational Academy, with or without high school diplomas or Associate Degrees, can be as skilled (or superior) to students who have gone the more traditional training route.

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APPENDIX I

LOCAL SCHOOLS OFFERING TRAINING IN ELECTRONICS

<u>SCHOOL</u>	<u>Job Title</u>	<u>Specialty</u>	<u>Length of Training</u>
<u>SCHOOL BOARD OF BROWARD COUNTY</u>			
B.F.James Adult Center	Electronics Assembler	General	5-7 wks.
Manpower Training Center	" "	"	5-7 wks.
Atlantic Vocational	" "	"	5-7 wks.
Sheridan Vocational	Computer Technician	Computers	9 mos.
Coral Springs High School	Electronics Technician	Communication Equipment Repair	
Miramar High School	" "	"	9 mos.
Nova High School	" "	"	9 mos.
Northeast High School	" "	"	9 mos.
Atlantic Vocational	Radio and TV Repair	Communications	36 wks.
<u>COLLEGES</u>			
Broward Community	Electronics Engineering Technician	General	2 yrs.
College of Boca Raton	" " "	General	
Nova College	/Two (2) Certificate Programs Available/		4 yrs.
<u>PRIVATE SCHOOLS</u>			
United Technical Institute	Electronics Assembler	General	6 wks.
" " "	Computer Technician	Computers	1 yr.
" " "	Test Technician	Communications	39 wks.
" " "	Electronics Technologist	General	91 wks.
Total Technical Institute	Field Service Technician	Computers	32 wks.
Brown Institute	Electronics Technician	Communications	35 wks.
(Emphasis on broadcasting equipment)			
South Florida Technical Institute	Electronics Engineer	General	60 wks.

APPENDIX II

SAMPLE CAREER LADDER

Career Step I

Job Title: Electronics Assembler

Entry Requirements:
Must not be colorblind,
No formal educational
requirements

Job Description:
-assembles electronic
equipment
-bolts components
-connect lead wires to
terminals
-solder wires to multiple
connectors
-fasten wires and cables

Career Step IIa

Job Title:
Test Technician

Entry Requirements:
-10th to 12th
grade reading
level, knowledge
of algebra

Job Description:
-compares wiring and
assembly details to
accepted models to
insure conformance
-investigates causes
for rejects
makes recommendations
for elimination of
causes of rejects

Career Step IIb

Job Title:
Computer Bench
Worker

Entry Requirements:
-8th grade reading
level

Job Description:
-Tests equipments
-before it leaves
factory
-Makes repairs so
that finished product
is in working order
-investigates source
of breakdowns

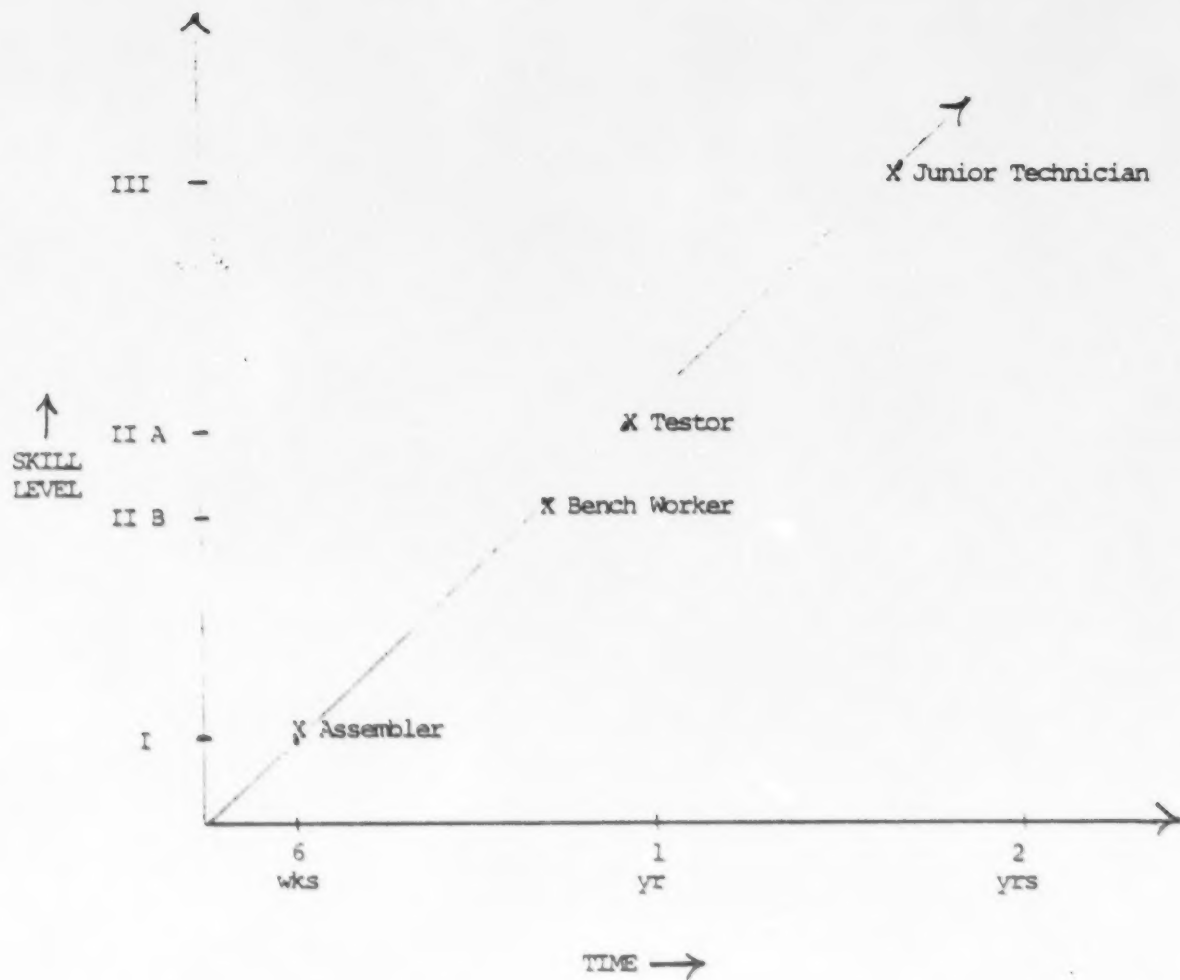
Career Step III

Job Title:
Junior Electronics Technician

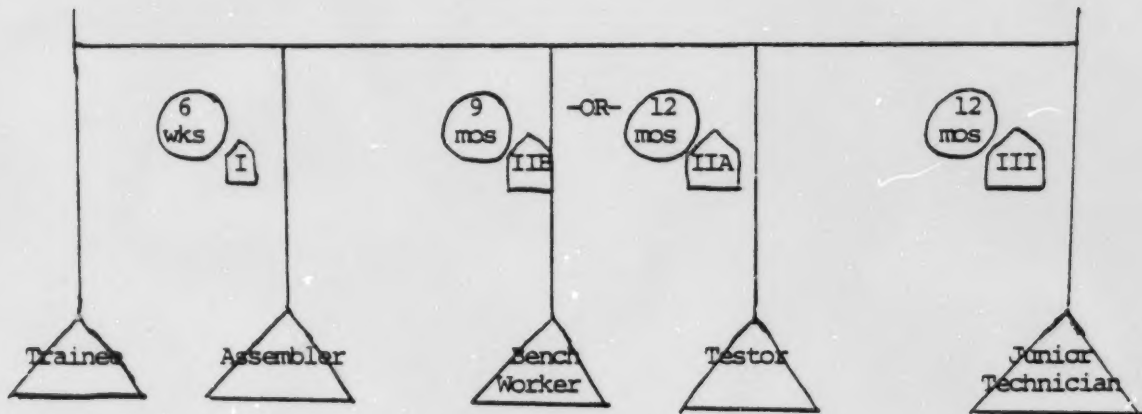
Entry Requirements:
-High School diploma,
12th grade reading level,
solid math background

Job Description:
-Assists engineers by wiring
and testing engineering models
of electronic devices
-uses or supervises the use of
engineering equipment and instruments
-analyzes and solves technological
problems
-prepares formal reports on experiments
and tests
-makes complex parts, components,
subassemblies

APPENDIX III
TRAINING PATH FOR ELECTRONICS



APPENDIX IV
MILESTONE CHART



KEY:

- Training or Schooling
- ⌂ Evaluation or Review
- △ Job Entry or Promotions (Possible Exit Points from School)

APPENDIX V
ELECTRONICS ASSEMBLY

Level 1 - Assembler (Entry Level)

Comments
(Optional)

I. Orientation to Electronics

- A. Occupational outlook for electronics
- B. Electronics as a career
- C. The career ladder concept

II. Basic Electronic Principles

- A. Current
- B. Resistance
- C. Insulators

III. Tools for Electronic Assembly

- A. Soldering Iron
- B. Soldering Aid
- C. Pliers
- D. Wire Strippers
- E. Screw Drivers
- F. Wrenches
- G. Selection of Tools
- H. Safety Procedures

IV. Soldering

- A. Introduction to soldering
- B. Contour Soldering Technique
- C. Use of sponge and cleaning solvents
- D. Nature of solder
- E. Types of solder
- F. Use of Flux
- G. Soldering printed circuits
- H. Dip soldering
- I. Wave soldering
- J. Soldering two connections
- K. Soldering three connections
- L. Desoldering techniques

V. Harness Fabrication

VI. Wire Wrapping

VII. Printed Circuit Boards

- A. Introduction
- B. Mounting components
- C. Mounting Diodes
- D. Mounting Integrated circuits
- E. Stress Bends on Components

VIII. Color Coding

- A. Introduction
- B. Purpose
- C. Examples
- D. Practice resistor readings according to color codes

IX. Pictorial Diagrams

- A. Purpose of schematics

- B. How to read schematics
- C. Uses in industry

X. Work Orientation

A. Interpersonal Relationships with supervisors

- 1. Accepting role
- 2. Asking questions
- 3. Work rules

B. Employer Expectations

- 1. Use of equipment
- 2. Confidentiality
- 3. Attendance
- 4. Punctuality
- 5. Grooming
- 6. Relationships with co-workers

COMMUNICATIONS

Level 2 A - Electronics Tester or Trouble Shooter

Comments
(Optional)

I. Basic concepts

- A. Electrical terminology
- B. Units of measurement
- C. Fundamentals of Magnetism
- D. Ohm's Law
- E. D.C. Power and Circuits
- F. Resistance
- G. Induction
- H. Capacitance

II. Electron Tubes

- A. Principles
- B. Diode Theory
- C. Triode Theory
- D. Power Requirements

III. Transistor Principles

- A. Semiconductor Theory
- B. Symbols
- C. Basic Transistor Circuits

IV. Circuits for Voltage and Current Distribution

- A. Voltage Dividers
- B. Series Circuits
- C. Parallel Circuits

V. Circuit Description

- A. Rectification
- B. Amplification
- C. Oscillation

VI. Power Supplies

- A. Function
- B. Types
- C. Identification
- D. Filtering

APPENDIX V CONT.

- B. How to read schematics
- C. Uses in industry

X. Work Orientation

A. Interpersonal Relationships with Supervisors

- 1. Accepting role
- 2. Asking questions
- 3. Work rules

B. Employer Expectations

- 1. Use of equipment
- 2. Confidentiality
- 3. Attendance
- 4. Punctuality
- 5. Grooming
- 6. Relationships with co-workers

COMMUNICATIONS

Level 2 A -- Electronics Tester or Trouble Shooter

Comments
(Optional)

I. Basic concepts

- A. Electrical terminology
- B. Units of measurement
- C. Fundamentals of Magnetism
- D. Ohm's Law
- E. D.C. Power and Circuits
- F. Resistance
- G. Induction
- H. Capacitance

II. Electron Tubes

- A. Principles
- B. Diode Theory
- C. Triode Theory
- D. Power Requirements

III. Transistor Principles

- A. Semiconductor Theory
- B. Symbols
- C. Basic Transistor Circuits

IV. Circuits for Voltage and Current Distribution

- A. Voltage Dividers
- B. Series Circuits
- C. Parallel Circuits

V. Circuit Description

- A. Rectification
- B. Amplification
- C. Oscillation

VI. Power Supplies

- A. Function
- B. Types
- C. Identification
- D. Filtering

APPENDIX V CONT.

VII. Low Frequency Amplifiers

- A. Types
- B. Application
- C. Function
- D. Loudspeakers
- E. Circuit Description
- F. Testing Procedures

VIII. High Frequency Amplifiers

- A. Selectivity
- B. Tuned Circuits
- C. Resonance
- D. Testing Procedures

IX. Oscillators and Frequency Converters

- A. Regeneration
- B. Circuit Description
- C. Frequency Mixing
- D. Tracking

X. Modulation

- A. Purposes
- B. Types
- C. Demodulation
- D. Automatic Volume Control

XI. Receivers

- A. Superheterodyne Circuitry
- B. Troubleshooting Techniques

COMPUTER TECHNOLOGY

Level 2 B - Bench Worker

Comments
(Optional)

I. Introduction to Computers

- A. Number Systems
- B. Logic Symbols, Boolean Algebra, Gate Networks
- C. Logical Designs and Circuits
- D. Digital Control and Measuring Devices

*II. Basic Concepts

- A. Electrical terminology
- B. Units of Measurement
- C. Fundamentals of magnetism
- D. Ohm's Law
- E. D.C. Power and Circuits
- F. Resonance
- G. Induction
- H. Capacitance

****III. Circuit Description**

- A. Rectification
- B. Amplification
- C. Oscillation

IV. Digital Computer Operation and Control

- A. Memory Systems
- B. Types of input
- C. Types of Output
- D. Operating Procedures

V. Troubleshooting

- A. Basic Procedure
- B. Power Supply Tests
- C. Problems in Data Transfer
- D. Memory Malfunction
- E. Adder and Adder Control Malfunctions
- F. Diagnostic Programs

* Same as Item I of Level 2 A.

** Same as Item V of Level 2 B.

APPENDIX V CONT.
COMMUNICATIONS Or COMPUTER TECHNOLOGY

Level 3 - <u>Junior Technician</u>		Comments (Optional)
I. <u>Fundamentals</u>		
A. Solenoids		
B. Alternators		
C. Generators		
D. Motors		
E. Use of volt-ohm-millimeter		
F. Use of Oscilloscope		
II. <u>Math Fundamentals</u>		
A. Decimals		
B. Powers		
C. Roots		
D. Scientific Notation		
E. Ratio and proportion		
F. Applications to Ohm's law, power formulas reactance formulas, voltage divider theorems		
G. Review of algebra		
H. Linear equations		
III. <u>Solid State Components</u>		
A. Active filters		
B. Comparators		
C. Differentiators		
D. IC Timers		
E. Measurement of gain		
F. Measurement of input impedance		
G. Measurement of output impedance		
H. Linear integrated circuits		
IV. <u>Electronics related Math</u>		
A. Review of trigonometry and factoring		
B. Numbering systems and methods of conversion		
C. Thevenin Theorem		
D. Norton Theorem		
E. Superposition Theorem		
V. Depending on specialization in Level 2, <u>terminology for computer electronics or communications electronics will be introduced.</u>		
VI. <u>Applications</u>		
A. Industrial systems and transducers		
B. Motor controls		
C. Sequence timing		
D. Induction and dielectric heating		
E. Temperature controls		
F. Troubleshooting techniques		
VII. <u>Advanced Mathematics</u>		
A. Introduction to calculus		
B. Transient waveform analysis		

APPENDIX V CONT.

VIII. Introduction to Physics

- A. Principles of force
- B. Motion
- C. Energy
- D. Power
- E. Friction
- F. Rotation
- G. Torque
- H. Gears
- I. Pulleys
- J. Mechanical aspects of electronic devices

IX. Technical Drawing - Basic Drafting Techniques

- A. Graphic symbols
- B. Basic lines and weights
- C. Lettering
- D. Dimensioning
- E. Applications to schematic diagrams

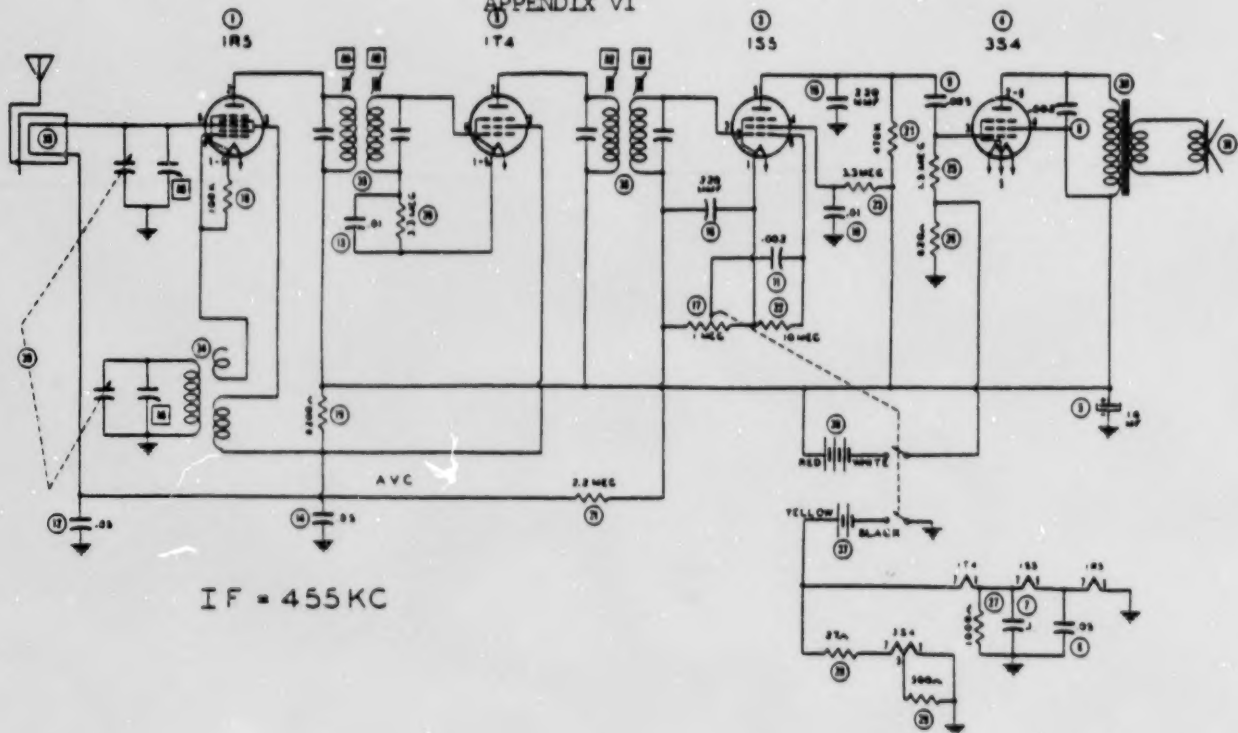
X. Technical Writing

- A. Organization of ideas
- B. Format

Name of Reviewer _____ Title _____

Company _____ Address _____

APPENDIX VI



Courtesy Emerson

FIG. 1. Portable receiver designed for operation on batteries.

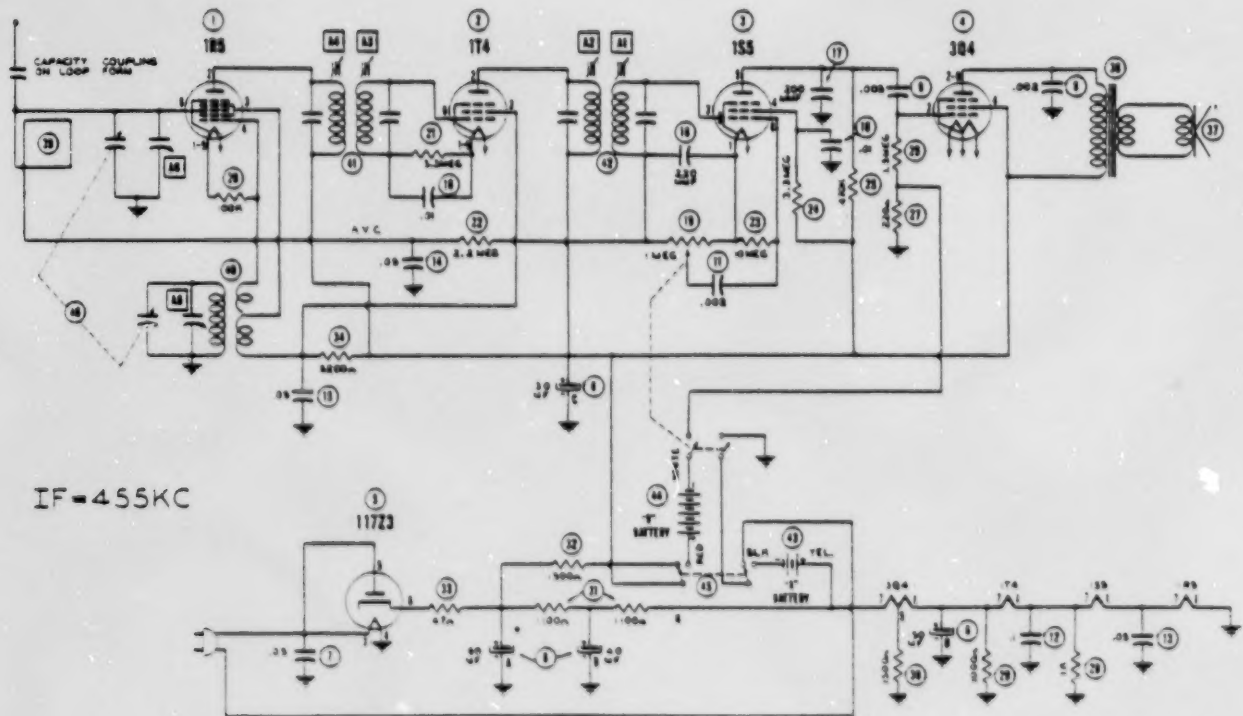


FIG. 2. Three-way portable receiver.

Courtesy Emerson

APPENDIX VII

1. GENERAL GLOSSARY for ELECTRONICS

The following definitions apply to terms used in electronic courses:

AC: Alternating current.

Alternate Current: An electric current that reverses direction in a circuit at regular intervals.

Ampere: A unit of electric current in the meter-kilogram-second system. It is the steady current that when flowing in straight parallel wires of infinite length and negligible cross-section, separated by a distance of one meter in free space, produces a force between the wires of 2×10^{-7} newtons per meter of length.

Amplification: The process of increasing the magnitude of voltage or current without altering any other quality.

Anode: A positively charged electrode of a battery or tube.

Bifurcated (split) Terminal: A terminal containing a slot or split in which wires or leads are placed before soldering.

Blister: Delamination in distinct local areas.

Bridging: A build-up of solder or conformal coating between parts, part leads and/or base substrate forming an elevated path (see fillet).

Capacitor: An electric circuit element used to store a charge temporarily, consisting in general of two metallic plates separated by a dielectric.

Cathode: A negatively charged electrode of a battery or tube.

Certification: The act of delegated authority in verifying and documenting that personnel have completed required training and have demonstrated specified proficiency and have met other specified requirements.

Circuit: A configuration of electrically or electromagnetically connected components or devices.

Cold Solder Joint: Unsatisfactory connection resulting from dewetting or movement of conductor during cooling and frequently exhibiting an abrupt rise of the solder from the surface being soldered. These usually appear frosty and granular.

Components: Parts of a electrical circuit or device.

APPENDIX VII (Cont'd)

Conduction Soldering: Method of soldering which employs a soldering iron for transfer of heat to the soldering area.

Conductor: A lead or wire, solid or stranded, or printed wiring path serving as an electrical interconnection between terminations.

Conformal Coating: A thin electrically nonconductive protective coating which conforms to the configuration of the covered assembly.

Connection: An electrical termination.

Cracked Solder Joint: A soldered connection which has fractured or broken within the solder.

Current: The amount of electric charge flowing past a specified circuit point per unit of time.

DC: Direct current.

Delamination: A distinct separation of FWB layers (resin from glass).

Dewetting: The condition in a soldered area in which the liquid solder has not adhered intimately, characterized by an abrupt boundary between solder and conductor, or solder and terminal/termination area.

Dielectric: A nonconductor of electricity.

Diode: Any electronic device that restricts current flow chiefly to one direction.

Direct Current: An electric current flowing in one direction.

Disturbed Solder Joint: Unsatisfactory connection resulting from relative motion between the conductor and termination during solidification of the solder.

Electrical Component: An assembly of one or more electronic/electrical parts that may be disassembled or separated without destruction of designed use, e.g., printed wiring assembly.

Encapsulating Compound: An electrically nonconductive compound used to completely enclose and fill in voids between electrical components or parts.

Energy: The work that a physical system is capable of doing while changing from one state to another.

Excessive Solder Joint: Unsatisfactory connection wherein the solder obscures the configuration of the connection.

APPENDIX VII (Cont'd)

Eyelet: A tubular metal part having both ends headed or rolled over.

Fillet: A smooth concave build-up of material between two surfaces; e.g., a fillet of solder between a part lead and a solder pad or terminal, or a fillet of conformal coating material between a part and a PWB.

Flux: A substance such as borax or rosin used to help metals fuse together by preventing oxidation.

Fractured Solder Joint: A joint showing evidence of cracking.

Hook Terminal: A terminal formed in a hook shape.

Induction: The generation of electromotive force in a closed circuit by a varying magnetic flow through the circuit.

Insulator: A material that prevents the passage of electricity out of a body or region.

Interfacial Connection: A conductor which connects conductive patterns between opposite sides of a printed wiring board.

Joint: A solder joint; a termination.

Mho: Unit of conductance reciprocal to the ohm (e.g., backward spelling of ohm).

Ohm: A unit of electrical resistance equal to that of a conductor in which a current of one ampere is produced by a potential of one volt across the terminals.

Ohmmeter: An instrument for direct measurement of the resistance of a conductor in ohms.

Ohm's Law: $A=V/R$ (e.g., current in amperes is equal to voltage divided by resistance).

Oscilloscope: An electronic instrument that produces an instantaneous visual display or trace of electron motion on the screen of a cathode-ray tube.

Overheated Joints: An unsatisfactory solder joint, characterized by rough solder surface.

Pad: A solder pad.

Parallel Circuit: A configuration of two or more two-terminal components connected between two points in a circuit with one terminal of each connected to each of the two points.

APPENDIX VII (Cont'd)

Part: One piece, or two or more pieces joined together which are not normally subject to disassembly without destruction of designed use. Synonymous with detail part and component part (e.g., resistor, capacitor, valve, relay).

Part Lead: The conductor, solid or stranded, attached to a part.

Plated-Through-Hole (PTH): A plated-through hole is one formed by a deposition of metal on the inside surface of the hole. Also known as a supported hole. The configuration is used to provide additional mechanical strength to the soldered termination or to provide an electrical interconnection on a multilayer printed wiring board.

Pierced (Perforated) Terminal: A terminal containing a hole through which leads or wires are placed before soldering.

Pits: Small holes or sharp depressions in the surface of the solder.

Polarity: The possession of two opposing attributes (e.g., positive and negative charges).

Porous Solder Joint: A joint having a grainy or gritty surface.

Potting Compound: An electrically nonconductive compound used to partially encapsulate or for a filler between parts, conductors, or assemblies.

Printed Wiring Board (PWB) Assembly: The PWB assembly consists of the printed wiring board, parts, and associated hardware and materials.

PTH: Plated-through-hole.

PWB: Printed wiring board.

Rectifier: A device, such as a diode, that connects AC to DC.

Repair: Operations performed on a nonconforming article to place it in usable condition. Repair is distinguished from rework in that alternate processes rather than reprocessing are employed.

Resistance: The opposition to electric current characteristic of a substance or circuit element.

Resistance Soldering: Method of soldering by passing a current between two electrodes through the area to be soldered.

Rework: The reprocessing of articles or material that will make it conform to drawings, specification or contract.

APPENDIX VII (Cont'd)

Rosin Solder Joint: Unsatisfactory connection which has entrapped rosin flux.

Schematic: A structural or procedural diagram, especially of an electrical system.

Semiconductor: Any of various solid crystalline substances such as germanium or silicon, having electrical conductivity greater than insulators but less than good conductors.

Series Current: An electric circuit connected so that current passes through each circuit element in turn without branching.

Solder: A nonferrous, fusible metallic alloy used to join metallic surfaces.

Solder Cup Terminal: A hollow, cylindrical terminal to accommodate one or more conductors.

Solder Icicle: A cone shaped peak or sharp point of solder usually formed by the premature cooling and solidification of solder upon removal of the heat source.

Solder Joint: A termination.

Solder Pad: Termination area on a printed wiring conductor.

Soldering: The process of joining metallic surfaces through the use of solder without direct fusion of the base metals.

Solenoid: A cylindrical coil of insulated wire in which an artificial magnetic field is established by a flow of electric current.

Staking Compound: An electrically nonconductive adhesive material used to anchor a part or component in place.

Straight Pin Terminal: A round post-type smooth terminal, with no grooves.

Stud Termination: An upright conductor termination through a printed wiring board.

Stress Relief: Method or means to minimize stresses to the soldered termination or part.

Terminal: A tie point device used for making electrical connections.

Termination: The point at which electrical conductors are joined.

APPENDIX VII (Cont'd)

Termination Area: A conductive surface on a printed wiring board used for making electrical connections (also referred to as a solder pad).

Thermal Shunt: A device with good heat dissipation characteristics used to conduct heat away from an article being soldered.

Tinning: The coating of a surface with a uniform layer of solder.

Transistor: A three-terminal semi-conductor device used for amplification, switching and detection, typically containing two rectifying junctions, and characteristically operating so that the current between one pair of terminals controls the current between the other pair, one terminal being common to input and output.

Triodes: A highly evacuated electron tube containing an anode, a cathode, and a control grill.

Tubelet: A tubular metal part. Its ends may or may not be flared.

Turret Terminal: A round post-type grooved stud around which conductors are fastened before soldering.

Volt: Unit of electromotive force or difference in potential between two points in an electric field that requires one joule of work to move a positive charge of one coulomb from the point of lower potential to the point of higher potential.

Voltage Divider: A number of resistors in series provided with taps at certain points to make available a fixed or variable fraction of the applied voltage.

Voltmeter: An instrument for direct measurement of potential differences in volts.

Watts: A unit of power equal to work done when a current of one ampere is passed through a resistance of ohm for one second.

Wetting: Flow and adhesion of a liquid to a solid surface, characterized by smooth, even edges, and a low dihedral angle.

Wicking: A flow of molten solder or cleaning solution by capillary action.

APPENDIX VII (Cont'd)

2. GLOSSARY for DIGITAL ELECTRONICS

The following definitions apply to terms used in digital electronics courses:

Bit: The smallest possible piece of information. The simplest statement that can be made. A specification of one out of two possible alternatives. Usually thought of as a statement of yes or no. Bits are written as 1 for "yes" and 0 for "no." These symbols are the same as those used in binary numbers, so a bit is also a binary digit. (See "Binary Number System.")

Boolean Algebra: A simple system for writing combinations of logical statements (statements that can be either true or false).

Branch: A program is said to "branch" where either of two possible instructions may be selected for execution next.

Buffer: A digital circuit with one input and one output. The output state is the same as that of the input. Used to "strengthen" a "weak" signal.

Building Block: In the field of electronic systems design, a combination of circuits or subsystems that can be used with other building blocks in many different combinations without redesigning. The simplest digital building blocks are logic gates.

Bus: Two or more conductors running in parallel used for carrying information. (Sometimes commonly used for power distribution conductors.)

Byte: A group of adjacent bits, usually a group formed for convenience in transmitting and receiving data (such as to and from a magnetic tape unit). Usually it takes more than one byte to make a word.

Capacitor: A device that stores electric charge in an electric or electronic circuit.

CCD: Charge-coupled device. A means for very dense serial-access storage of bits as tiny packets of electric charge moving along the surface of a semiconductor chip.

Channel: In MOS transistors: the conducting portion between the main terminals, formed by the gate signal. In electronic systems: a path along which signals can be sent, such as data channel.

APPENDIX VII (Cont'd)

Character: A symbol whose image is formed by a display system for representation of information. Examples are numerals, letters, decimal point, punctuation marks, and special symbols indicating status of an electronic system. Examples are overflow or errors in a calculator.

Circuit: Strictly speaking, a circuit means a path for electricity from one terminal of a power supply (imagine a battery) through wires and usually through electrical or electronic devices, and back to the other terminal of the power supply. "Circuit" is also used to refer to a group of electric or electronic devices connected together to perform a certain job or function.

Clear: To remove data and return all circuitry to an initial condition, usually "0".

Clock Input: An input terminal on a building-block typically used for receiving a timing control-clock signal, but used in some applications for a control signal or even data.

Clock Generator: A building block that generates clock signals.

Clock Signal: A regularly repeated signal supplied to more than one part of a system or subsystem to make things happen at the same time.

CMOS Integrated Circuit: A digital integrated circuit whose gates use both n-channel and p-channel MOS transistors in such a fashion that almost no current flows when a gate is not switching from one output state to another.

Code: A set of meanings or rules assigned to groups of bits. Each combination of bits (that is, each binary number that can be formed) has a certain meaning following certain rules in terms of a number, a character, an instruction, etc.

Code Converter: A name for a class of combinational building blocks to receive information in one code and transmit the same information in another code. With respect to one particular code (say, the BCD code used for numbers in a calculator) a building block that converts to this code is called an "encoder," and a building block that converts from this code is called a "decoder".

Combinational Building-Block or Network: A group of logic gates (perhaps just one) with no ability to store information, typically with several inputs and several outputs. For every combination of bits at the inputs, there is a definite, prearranged combination of bits at the outputs.

Comparator: A building-block that compares two binary numbers. There are several kinds of comparison: telling when the numbers are equal, when one is greater, when one is greater-than-or-equal-to the other, and so forth.

APPENDIX VII (Cont'd)

Complement: Usually means the "ones complement" of a bit, which is simply the inverse of the bit. To "complement" a number means to subtract it from a certain number (from one, in the case of ones complement).

Computer: A digital computer consists of at least one main frame, together with various peripheral input, output, and memory units. Distinguished from "minicomputer" and "microcomputer" by size and speed: longer words, larger memory, faster operation, more ALU operations, and generally more sophistication and flexibility.

Conductor: Something that conducts electricity from one place to another. It may be a wire, a metal strip on a printed-wiring board, a metal strip on the surface of an integrated-circuit chip, or a channel of semiconductor material inside an IC chip.

Controller: The parts (perhaps a subsystem) of a programmed system that select stored instructions, interpret them, and transmit control signals to the other parts of the system.

Core: A tiny ring of magnetic material that stores a bit as a permanent magnetic field. A "core memory" typically contains thousands or millions of cores.

Counter: A special kind of register made up of flip-flop circuits with one input and usually with a parallel output from each flip-flop, which counts pulses arriving at the input and stores the total count in a certain code (usually binary numbers).

CPU: Central Processing Unit. A section of a computer (or computer like system) consisting of a controller, some registers, and an ALU.

CRT Terminal: Cathode-ray-tube terminal. A computer terminal with a screen similar to that of a television receiver, together with a keyboard.

D Flip-Flop: A clocked flip-flop with one data input (called "D"), whose "true" output changes at a clock signal to the state maintained at D during the clock signal.

Decoder: See "Code Converter." Loosely speaking, "decoder" may be the name used for a combinational building-block receiving several parallel inputs which "recognizes" one or more combinations of input bits and puts out a signal when these combinations are received.

Dedicated: A dedicated system (say, a computer) is one that's limited to one particular job by the way it's built into a larger system (say, a process controller).

APPENDIX VII (Cont'd)

Diode: Any electronic device with two electrodes (terminals.) Usually means a "p-n junction diode." which is a rectifying device (passes current only one way) consisting of a p-region and an n region touching each other in the same semiconductor crystal.

Dopant, Doping: A substance added to semiconductor material to make it p-type or n-type is called a "dopant". Adding this substance is called "doping".

Driver: A circuit that provides digital signals with enough power to "drive" (operate) something other than a few nearby gates, such as LEDs in a display, magnetic cores in a memory, etc.

Dynamic Storage Circuit (or "Unit"): An electric circuit that stores one bit in the form of an electric charge in a capacitor (or in part of a circuit that acts as a capacitor). Two such circuits may be connected together to store a bit in master-slave style.

ECL: Emitter-coupled logic. Also, called "current-mode logic." General design principle for a bipolar logic gate that achieves fast propagation delay by diverting internal current from one path to another rather than switching saturated transistors on and off. A family of integrated circuits using gates like this.

Electric: Something that uses electricity. Some electric devices and circuits and systems are also "electronic."

Electronic: Something that uses electronic devices. Electronic devices are "vacuum" tubes (including gas-filled electron tubes; and solid-state semiconductor devices.

Epitaxial: An "epitaxial Layer" on a semiconductor or slice or chip is a thin layer of semiconductor crystal growth from a hot gas.

EPROM: Erasable and programmable read-only memory. An IC memory chip whose stored data can be read at random. The data can be erased and new data can be stored, but only by a special system other than the one in which the memory is used.

Exclusive-Or Gate: A device or circuit with two (not more) inputs of binary digital information and one output, whose output is 1 when either input is 1 and 0 if neither or both inputs are 1. It acts as a certain combination of other gates.

APPENDIX VII (Cont'd)

Family: A family of digital integrated circuits is a group of IC's that use the same general design style for all gates, are processed during manufacture in much the same way, and whose input and output signals are all "compatible" with one another so that one can transmit to another.

Flag: A flag is a bit stored in a certain place, which the system uses as a "reminder" of something that's been done or something that needs to be done.

Flip-Flop: A building-block having two stable states that stores one bit by means of two gates (ordinarily NAND or NOR gates) "cross-coupled" as a latch, with the output of each forming an input to the other. It is capable of changing from one state to the other by the application of a control signal, but will also remain in that state after removal of the signal. A master-slave flip-flop contains two such latches. Most flip-flops contain additional features to make them more versatile.

Frequency: How often regular waves or pulses occur in a circuit or other transmission medium such as radio. Frequency is measured in hertz (cycles per second) and multiples of hertz.

Function Table: The function table for an electric or electronic binary digital circuit shows, the output electrical state that results from each combination of electrical states at the inputs. For binary electronic circuits, the states are either "high" or "low", "on" or "off", "open" or "closed." In examples in this book where voltages are not specified, "on" means high, and "off" means low.

Gate: A "logic gate" is an AND, OR, NOT NAND, NOR or "Exclusive-OR" gate. In an MOS transistor, the "gate" is the metal plate for holding the charge to control the transistor.

Hardware: The actual physical parts and structure of a system, subsystem, etc. as opposed to "software" that may control its operation.

Hard-Wired: Describes a system, subsystem or building-block which does not contain stored instructions that control its operation. Its operation depends only on the way it is put together, and on inputs it receives.

IC: See "Integrated Circuit,"

EL: I-squared-L, or "integrated injection logic." A certain type of logic gate that uses essentially only one bipolar transistor. A family of integrated circuits based on gates like this.

APPENDIX VII (Cont'd)

Inductor: Any device that makes electric interact with a magnetic field, typically by means of a coil of wire.

Input: An information signal coming into a system or a part of a system. Can also mean the wire that carries the incoming information.

Instruction: A string of bits in a certain combination, stored in a "programmed" digital system such as a calculator. Each instruction contains information in a special code that tells the system what to do next.

Instruction Cycle: The period of time during which a programmed system obeys a particular instruction.

Integrated Circuit ("IC"): A small package with electrical terminals containing a chip of silicon. The surface of the silicon is processed to form hundreds or thousands of transistors and other devices. These make up an electronic circuit.

Inverter: A binary digital building-block with one input and one output. The output state is the inverse (opposite) of the input state.

J-K Flip-Flop: A clocked flip-flop with two inputs called J and K which acts as a clocked R-S flip-flop, except that when clocked while both J and K are 1, it toggles to the opposite state rather than an unknown state like an R-S flip-flop.

Latch: A one-bit latch is a circuit with an input and an output for digital information, and a third input for a control signal. The control signal makes the output either follow the input or be held in its present state. Several latches used together with the same control signal to each (say four of them) would be a type of register called a j-bit latch. Also see "R-S" "Latch" and "S-R Latch."

Light-Emitting Diode (LED): A sort of semiconductor "light bulb" made of a small piece of semiconductor material (such as gallium phosphide) that makes light when electric current is passed through it in a particular direction, by way of two terminals.

Logic Diagram: A diagram using symbols for gates, flip-flops, building-blocks, etc., and showing connections between these parts.

LSB or LSD: Least-significant bit or digit. The bit or digit at the "right" end of a number, with the smallest numerical value.

LSI: A level of complexity of integrated circuits, such that a complete major subsystem containing 100 or more gates (or equivalent circuits) is fabricated in one integrated circuit.

APPENDIX VII (Cont'd)

Magnetic Bubble: A tiny moveable magnetized region formed under certain conditions in a thin film of magnetic garnet crystal fabricated similar to an IC. Such bubbles provide very dense serial-access storage of bits.

Magnetic Tape, Drum, Disk: Types of serial-access mass memory that store bits as tiny magnetized spots in moving magnetic material, used for peripheral storage in a computer system.

Main Frame: A section of a computer consisting of a CPU and a random-access mass memory.

Memory: In a digital system, a "memory" or a "memory unit" is a part of the system where information is stored.

Microaddress: See "Microprogram."

Microcomputer: A computer in the lowest range of size and speed, generally smaller, slower, and less sophisticated than a "mini-computer."

Microprocessor: An IC (or set of a few ICs) that can be programmed with stored instructions to perform a wide variety of functions, consisting at least of a controller, some registers, and some sort of ALU (that is, the basic parts of a simple CPU).

Microprogram: Certain programmed systems are "microprogrammed," meaning that they have two levels of programming. Each instruction in the "upper" or "main" level typically causes execution of a routine at the lower or "microprogrammed" level. Such a routine consists of "microinstructions" stored at "microaddresses" in a memory unit that's typically a ROM, PROM, or EPROM. Some systems (such as non-programmable calculators) operate only with micro-programming.

Minicomputer: A computer in a certain range of size and speed, generally smaller, slower and less sophisticated than a "computer."

Modulus: The modulus of a counter is the number of states it counts through before returning to the beginning state. Written as "Modulo" when used as a prefix, as in "modulo-12 counter."

Modulation: The controlling of a certain property of electricity so as to transmit information in analog form.

MOS Integrated Circuit: A digital integrated circuit whose transistors are all (or nearly all) MOS transistors. Varieties include n-channel MOS, p-channel MOS, and CMOS integrated circuits.

MOS Transistor: A class of transistors that operate by means of an electric field produced by a voltage on a metal plate called the "gate." The field acts through a thin layer of oxide insulation upon a semiconductor channel, controlling its depth and therefore controlling current through the channel.

APPENDIX VII (Cont'd)

MSB or MSD: Most-significant bit or digit. The bit or digit at the "left" end of a number, with the largest numerical value.

N-Type Semiconductor Material: Semiconductor material (such as silicon) containing a very small proportion of certain other elements (such as phosphorus), causing any current through the material to be conducted mainly by the movement of negative charges ("free" electrons).

NAND Gate: A binary digital building-block that acts as an AND gate followed by an inverter.

Negative Logic: In electronic binary digital circuits, this means the decision to let the more negative of the two voltage levels represent 1 and to let the less negative level represent 0.

Noise: Any signal that isn't supposed to be there, Electrical noise may be caused by small, irregular sparks when a switch is opened or closed. Or it may be caused by radio waves or by electric or magnetic fields generated by one wire and picked up by another.

NOR Gate: A binary digital building-block that acts as an OR gate followed by an inverter.

NOT Gate: Occasionally, used to mean "inverter."

OR Gate: A device or circuit with two or more inputs of binary digital information and one output, whose output is 1 when any one or more inputs are 1. The output is 0 only when all inputs are 0.

Output: An information signal going out of a system or a part of a system. Can also mean the wire that carries this outgoing information.

P-Type Semiconductor Material: Semiconductor material (such as silicon) containing a very small proportion of certain other elements (such as boron), causing any current through the material to be conducted by the movement of positive charges ("holes" among "bound electrons").

Parallel Circuit Connection: Two or more electrical devices (such as switches or transistors) are said to be connected "in Parallel" when two terminals of each device are connected to the same two points, so that current can pass from one point to the other through any of the devices.

APPENDIX VII (Cont'd)

Parallel Data Transmission: Two or more bits of a group are said to be transmitted "in parallel" when they are all transmitted at the same time (as in a group of wires) from the same source to the same destination.

Parallel Register: Two or more flip-flops (or dynamic storage units) with a common clock signal, used to store bits transmitted in parallel.

Peripheral: In a computer system, "peripheral" units or equipment are those outside the main frame, including disk and tape units, printers, keyboard terminals, etc.

Phase: The time interval for each clock "cycle" in a system may be divided into two or more "phases" (like the phases of the moon). The phases are defined by pulses in a separate network of wires for each phase. During a particular phase, the signal in that clock network is in the state defined as "active" (let's say the "high" or "1" state). The clock cycles are repeated over and over again, phase by phase. The phases provide a method of making several things happen in the proper order during one clock cycle.

Photomask: A transparent glass plate carrying an intricate, very precise pattern of microscopically small opaque (dark) spots photographically reduced from a larger pattern. The opaque spots represent areas on a semiconductor slice into which a dopant will be diffused, or areas of metal that will be etched away.

Photoresist: A liquid that, when spread in a thin film and dried, quickly hardens into a tough plastic substance where struck by ultraviolet light. When the unhardened areas have been washed away, the material beneath is exposed for etching by an acid. The hardened areas "resist" the acid.

Positive Logic: In electronic binary digital circuits, this means the decision to let the "higher," more positive of the two voltage levels represent 1 and to let the "lower," more negative level represent 0. Positive logic is always assumed in this book unless "negative logic" is specifically stated.

Potentiometer: A variable resistor with three terminals, normally used for transmitting a manually variable voltage ("potential") part-way between voltages supplied at two main terminals of the device.

Program: In a programmed system, any group of instructions that are "programmed," meaning planned so that one instruction leads to another.

APPENDIX VII (Cont'd)

Program Counter: In a programmed system, the parts that provide a method for adding 1 to the address of the current instruction. May consist of the address register and an adder.

Programmed System: A system that operates by following a series of stored instructions. Also called "variable-program" system, since the instructions can be changed.

PROM: Programmable read-only memory. An IC memory chip whose stored data can be read at random. The data is stored permanently by the user after the chip is manufactured, and cannot be changed afterward. Storing data in this fashion is loosely called "programming" the memory.

RAM: Random-access memory. A memory with a number of storage locations, where words may be "written" (stored) or "read" (recovered) in any order at random.

Refresh: To refresh a dynamic storage unit means to restore its charge to the desired voltage level.

Register: A certain type of temporary storage unit for digital information.

Relay or Electromechanical Relay: A mechanical switch with a moving contact called an "armature" that is moved by a magnetic field generated by electricity in a coil of wire.

Reset: To "reset" a stored bit means make it a "0."

ROM: Read-only memory. A memory unit containing data permanently stored when the unit was manufactured. Usually an IC chip with each bit stored as a permanent electrical connection of some sort, which can be read at random.

Routine or Programmed Routine: A series of instructions followed by a programmed system in doing a particular job. Usually contained within a main program. It may occur over and over again. The instructions are "Programmed," meaning planned so that each instruction leads to another. A routine can even be one instruction followed over and over again.

R-S Flip-Flop: Any of several kinds of flip-flops, in which a momentary 1 at the R (reset) input changes the "true" output to 0, and a momentary 1 at the S (set) input changes the "true" output to 1.

R S Latch: A simple kind of R-S flip-flop.

S R (S-Bar, R-Bar) Latch: A simple kind of flip-flop.

APPENDIX VII (Cont'd)

Schottky Diode: A type of rectifying (one-way) diode formed simply by a metal terminal contacting a lightly-doped region in a semiconductor crystal. Its low "forward voltage drop" and quick response to pulses make it useful in improving the performance of TTL circuits.

Semiconductor: "Semiconductor material" is various solid substances such as silicon, germanium, and gallium phosphide. When made in nearly pure crystal form, these materials conduct electricity in very special, useful ways. A "semiconductor device" (or just a "semiconductor") is a transistor or diode (or other similiar things) made using semiconductor material.

Sequential Building-Block or Network: One or more flip-flops or dynamic storage units, typically with one or more logic gates, and typically with several inputs and several outputs. The combination of bits at the outputs does not depend only on the combination at the inputs at the present moment, but on past history of a sequence of input combinations over a period of time.

Serial-Access Memory: A memory in which the stored data is accessible for reading or writing only in a definite, fixed order rather than at random.

Serial Data Transmission: Two or more bits of a group are said to be transmitted "in series" when one at a time is transmitted through the same wire. Such transmission is called "serial" transmission.

Series Circuit Connection: Two or more electrical devices (such as switches or transistors) are said to be connected "in series" when they form a chain from one point to another, so that the same current flows through all of them.

Set: To "set" a stored bit means make it a "1."

Shift: A movement of stored data right or left.

Shift Register: Two or more flip-flops (or dynamic storage units) with a common clock signal, connected in series so that stored bits shift one stage during each clock cycle.

Signal: A word used in describing the operation of electric or electronic circuits. It means electrical voltage or current or waves carrying information, or the information itself.

Software: The stored instructions (or "program") that control a programmed system as opposed to (the "hardware" of which the system is physically constructed.

APPENDIX VII (Cont'd)

Subsystem: A smaller system inside a larger system. Each subsystem can be thought of as a separate system with its own job to do.

Sum: In arithmetic, the result of an addition. In Boolean algebra, the OR function of two or more variables.

Switching Circuit: An electric or electronic circuit whose output (or outputs) are in definite electrical states, rather than varying over a wide range. The switching circuits used in binary digital systems have only two possible states. These are usually two different voltage levels.

Synchronous: Refers to two or more things made to happen in a system at the same time, by means of a common clock signal.

System: In general, a system is a group of things that work together as a unified whole. In electronics, a system is a group of device or circuits or subsystems that work together to do a certain job.

T Flip-Flop: A flipflop with an input called "T." whose outputs "toggle" to the opposite states on receiving a signal at T.

Terminal: A computer terminal is an input and output device operated by a person. Input is usually by a keyboard. Output is usually by typewriter or CRT screen.

Transducer: A device that converts information from one medium (say, the position of a control knob) to another (say, electronic digital signals).

Truth Table: The truth table for a binary digital building-block shows, for each information output, the logic state that results from each combination of logic states at the information inputs. The logic states are 1 (yes, true) and 0 (no, false).

TTL or T²L: Transistor-transistor logic. A certain style of circuit design for a logic gate using two bipolar transistors. A broad family of integrated circuit types whose gates employ the general principle of this basic two-transistor arrangement.

Volatile: A volatile memory is one that loses its stored data when the electric power is turned off.

Word: A group of bits or string of bits handled as a unit usually stored at a certain address in a random-access memory (RAM).

Write: To record data in a storage or data medium.

YIG: Yttrium-iron garnet. A magnetic crystalline material suitable for holding magnetic bubbles.

Appendix VIII
Electronics Curriculum Mailing

<u>Name</u>	<u>Title, Company</u>	<u>Address</u>	<u>Telephone</u>
David Rush	President, ACR Electronics, Inc.	3901 N. 29th Avenue Hollywood, Fl. 33020	921-6262
L.N.McLenagan	President, AMF Inc. (Electro-Components Div)	4105 Pembroke Rd. Hollywood, Fl. 33021	981-1211
S.A. Mixsell	General Manager, Airpax Electronics, Inc. (Controls Div.)	6801 W. Sunrise Blvd. Plantation, Fl. 33313	587-1100
Jas. E. McLaughlin	President, Atlantic Coast Electronics (Div. of Tyco Labs, Inc.)	2681 N.E. 4th Avenue Pompano Beach, Fl. 33064	943-7300
Jack N. Holcomb	President, Audio Intelligence Devices	1400 N.W. 62nd St. Ft. Lauderdale, Fl. 33309	776-5000
Al Scarborough	Mgr., Employee Relations Bendix Avionics	2100 N.W. 62nd St. Ft. Lauderdale, Fl. 33309	776-4100
John K. Cotton	President, Burroughs Corp.	3050 N. 29th Court Hollywood, Fl. 33020	929-1211
Jerry Shames	General Manager, Burroughs Corp. (Components Group)	4000 Coral Ridge Dr. Coral Springs, Fl. 33065	752-7920
David Yoder	President, Computer Products, Inc.	1400 N.W. 70th St. Ft. Lauderdale, Fl. 33309	974-5500
Robert Bryden	President, Dynalco Corp.	5200 N.W. 37th Avenue Ft. Lauderdale, Fl. 33309	739-4300
Howard Thraikill	VP & General Manager Harris Corp. (Computer Systems Div.)	2101 Cypress Creek Rd. Ft. Lauderdale, Fl. 33309	974-1700
Tony Walker	President, DIELCO (Diversified Electronics Components)	2775 A Cypress Creek Rd Ft. Lauderdale, Fl. 33309	973-8700
Elias N. Ede	President, Medcor, Inc.	5920 Rodman Street Hollywood, Fl. 33021	983-5100
Ann Derby	Personnel Recruiter, Modcomp (Modular Computer Systems, Inc.)	1650 McNab Road Ft. Lauderdale, Fl.	974-1380
Ralph Parilla	Personnel Manager, Motorola, Inc.	8000 W. Sunrise Blvd. Plantation, Fl. 33313	473-6000
John Biggie	Chairman of Board, Multronics, Inc.	730 McNab Road Ft. Lauderdale, Fl. 33309	974-0300

Electronics Curriculum Mailing (Cont'd)

<u>Name</u>	<u>Title, Company</u>	<u>Address</u>	<u>Telephone</u>
Becky Hall	Personnel Director Novatronics, Inc.	500 S.W. 12th Ave. Pompano Beach, Fl. 33061	942-5200
Taro Takahashi,	C.E.O., Oki Electronics of America, Inc.	4031 N.E. 12th Terrace Ft. Lauderdale, Fl. 33308	563-6234
Bill Lindquist	Plant Mgr., PEC Indus- tries, Inc. (Sub. Reliance Electric Corp.)	3000 S.W. 4th Ave. Ft. Lauderdale, Fl. 33315	525-4317
*Ronald Assaf	President, Sensormatic Electronics	500 N.W. 12th Avenue Deerfield Beach, Fl. 33441	427-9700
Leon Popeil	Vice Pres. of Mf'ng. Sonar Electronics Corp.	3000 Stirling Rd. Hollywood, Fl. 33021	981-8800
Everett A. Cooper	President, Sunair Electronics, Inc.	3101 S.W. 3rd Avenue Ft. Lauderdale, Fl. 33315	525-1505
Gary McCoy	Training Manager Systems Engineering Labs, Inc.	1700 N.W. 66th St. Plantation, Fl. 33310	587-2900
James C. Floyd	President, Tropical Circuits Co.	1981 S.W. 36th St. Ft. Lauderdale, Fl. 33301	467-3771
Andrew C. Thompson	President, Whitewater Electronics, Inc.	201 S.W. 33rd St. Ft. Lauderdale, Fl. 33315	525-7631
Rick Rubles	Manager of Personnel & Industrial Relations UID Electronics	4105 Pembroke Rd. Hollywood, Fl.	981-1213
David L. Withers	Director, So. Florida Technical Institute	201 W. Sunrise Blvd. Ft. Lauderdale, Fl. 33311	764-3432
Winnie Dickinson	Director, Vocational, Technical and Adult Education, School Board of Broward County	1350 S.W. 2nd Court Ft. Lauderdale, Fl. 33312	765-6755

*Researchers spoke to Mr. Bowers on telephone.

Appendix IX

Electronics Firms Reviewing Curriculum

1. John F. Flood, Vice President
ACR Electronics, Inc.
3901 N. 29 Avenue
Hollywood, Florida 33020
2. Ted McLaughlin, President
Atlantic Coast Electronics
2681 N.E. 4 Avenue
Pompano Beach, Florida 33064
3. Ann E. Derby, Personnel Representative
Mod Comp Inc.
1650 West McNab Road
Fort Lauderdale, Florida 33310
4. John L. Schick, Director Manufacturing Operations
OKI Electronics of America, Inc.
4031 N.E. 12 Terrace
Fort Lauderdale, Florida 33334
5. George S. Brooks, Personnel Manager
Sunair Electronics, Inc.
3101 S.W. 3 Avenue
Fort Lauderdale, Florida 33315
6. Gary McCoy, Training Manager
Systems Engineering Labs, Inc.
1700 N.W. 66 Street
Plantation, Florida 33310
7. T. K. Chapman, General Manager
Universal Electronics
201 S.W. 33 Street
Fort Lauderdale, Florida 33315
8. Frederick Webster, Owner
Chuck's T. V.
703 S. Federal Highway
Pompano Beach, Florida 33062
9. Evert Williams, President
Graphic Products, Inc.
1140 N.W. 55 Street
Fort Lauderdale, Florida
10. Becky Hall, Personnel Director
Novatronics, Inc.
500 S.W. 12 Avenue
Pompano Beach, Florida 33061

APPENDIX X

THE VOCATIONAL ACADEMY

A Manual For Incoming Students

James E. Kelly
Research Assistant

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What Is The Vocational Academy?

The Vocational Academy is a CETA supported program which designs innovative training programs for the poor and unemployed.

In addition, the program offers basic education help in the areas of reading, writing, and mathematics.

At the Vocational Academy, there is the opportunity to acquire additional skills and to advance beyond the entry level as high as you are able in the field of electronics.

Why Electronics?

Electronics is a rapidly growing industry in Broward County. Current labor market predictions suggest an increase in the number of jobs in electronics in the next few years.

In addition, the Industrial Council of Broward County is actively encouraging electronic companies to move into Broward.

What Courses Do I Take?

The curriculum recommended by the Vocational Academy offers three major areas of study with advancement according to training and work experience:

- 1) Electronic Assembly - 6 weeks
- 2a) Electronics Tester in Communication - 8 months
- 2b) Digital Testor - about 10 months

The courses required for each major area are listed in the curriculum discussion of this compendium.

What Are My Chances of Getting a Job After Training?

While the Vocational Academy cannot guarantee you a job after training, your chances will be increased because of your training, an orientation to the world-of-work preparation and the "job seeking skills" segment of your regular classroom activities.

In addition, it is the policy of the Vocational Academy to enforce safety rules as well as the dress code which may be in existence in the industry.

Finally, BETA students are paid minimum wages while attending class. To simulate a work environment you will be required to punch a time clock and will be paid hourly according to the number of hours shown on your time card.

What Skills Are Taught in the "Job Seeking Skills" Segment For Assembler?

- 1) How do I find a job?
- 2) How do I groom for a job interview?
- 3) What shall I wear to the interview?
- 4) How do I benefit from social security?
- 5) What do I have to know about my pay stub?
- 6) What are employee benefits?

Each week of these topics are addressed and small group discussions will be held.

How Do I Find A Job?

There are several ways to locate a potential job. We will discuss each of these separately below. The first method is to contact the training agency placement service. Here you will find many different kinds of jobs listed. Most likely all of the electronic jobs will be posted together. There are several ways jobs may be listed. Sometimes only limited information is given on a 3" x 5" card, and you must get further information from someone in charge of the placement service. (See example below)

Job #468
Electronics Assembler
West Broward
\$6.75/hr.
An Equal Opportunity Employer

Fig. 1 Sample Job-Opening Card.

Suppose you are interested in Job #468 (above). You approach the placement clerk and find out that the employer is MOTOROLA. The contact person is John Lerner and you must call for an appointment - Telephone number 475-2669. That is how the placement office works.

A second method of finding a job is to check the classified section of a daily newspaper (see advertisement which follows). Generally, the larger the circulation of the news-

paper, the more jobs you will find listed in the classified section.

To find an electronics job, you turn to headings such as Industrial or Technical Trade in the "Help Wanted" section of the newspaper.

There are advertisements (ads) with different kinds of information in the paper. Some list the company's name and address, others list only a phone number telling you to call for an appointment. Finally, some have a post office box number to which you must write for information.

The sample "Help Wanted" ads attached, are slightly different. Notice that the first ad is very large. Usually, larger companies have more detailed ads. The marked, more detailed ad is from Panasonic, an international company. The ad also tells you the job is in Hialeah. That is important to know if you do not wish to travel a long distance to work. It also says interviews are held on Tuesday and Wednesday - which suggests that you should apply for the job only on these days and that you should apply fairly quickly or they will fill that job.

Finally, the ad tells you to call Mr. Mansfield. If you were to just show up, without an appointment, you may not see Mr. Mansfield or get the job.

Let us turn to ad two now. Here is a small ad which may indicate that it is with a small company. In the first ad no salary was mentioned whereas in the second ad it states that the employee will be paid \$20 per set. This is called "piece work". The name of the firm is AAA TV. It also give a phone number to call for an appointment. Notice that the first ad provides more information than the second one.

You should have some questions to ask the personnel representative of AAA TV. Write your questions below.

Here are some sample questions you might wish to ask after you express an interest in the job?

- 1) To whom am I speaking?
- 2) Where are you located?
- 3) What are the hours?

If invited for an interview you may want to ask about the benefits that are available to employees.

Monday, August 18, 1980

J1-88 Technical

CUSTOM PRINTER

Good pay and benefits with National Company. Must have 1 year experience in retail printing. Call (714) 444-1444.

ELECTRONICS TECHNICIAN

Local Interviews

Personnel Service Center located in Miami has an excellent opportunity for a local electronics technician with a good background in repair of audio and/or television.

We offer all necessary paid benefits, good working conditions, and competitive salary. Interview on Wednesday or Thursday, call:

Mr. Mitchell

555-5155

PANASONIC

Equal Opportunity Employer

DENTAL CLINIC in W. Fort. We are looking for a sharp, quality oriented individual with dental background. Must work well with others. Excellent compensation and benefits. All routine dental care. Send resume & salary requirements to: Horne Adv 1000.

ELECTRICAL ESTIMATOR

For large electrical contracting firm. 3-5 yrs. experience. Adv 1000.

AVIATION Supervisory & technical jobs needed for new aviation facility at Ft. Lauderdale. Pay commensurate to experience. Call: Horne Adv 1000.

PASTEL ARTIST

3-5 months temporary assignment for entry level pastel artist. Send three advantage background preferred.

For further information call: (404) 444-1444 Ext. 411 Main-Fri 10AM-3PM.

EQUAL OPPORTUNITY EMPLOYER

AUTOMOTIVE INSTRUCTOR Former expanding local private institution. Particularly strong in front suspension, steering.

Call: Horne Adv 1000.

ARTIST We need a self-motivated commercial artist to work for a progressive manufacturer. Background in illustration, photography, line graphics, etc. & must. Excellent benefits and salary. Call: Horne Adv 1000.

OVERSEAS

Electronic techs & communications techs. Adv 1000.

DRAFTSPERSON

For large store fixture house. Store drawing experience necessary. Will train. Call: Horne Adv 1000.

DRAFTSPERSONS

Consulting engineering firm requires draftspersons for water & sewer projects. Weeds commensurate with experience. Equal Opportunity Employer. Adv 1000.

Marine Operations

Major shipbuilding company has immediate opening for experienced marine operations person to assist the operations manager in the day-to-day responsibilities of managing 10 vessels and can handle crew, purchasing, maintenance, etc. License desired. Excellent company benefits. Salary commensurate with experience. Call: Horne Adv 1000.

TV BENCH TECHNICIAN

Call: Horne Adv 1000.

J1-88 Industrial

Supervisor

Apprentice individual capable of supervising 12 people called for immediate interview. Adv 1000.

EXPERIENCED heavy machinery repairer

Call: Horne Adv 1000.

TRUCK CHECKER

TO check in bar route trucks and determine if they are safe to use. Must be able to read and understand trucking regulations. Must be able to communicate with drivers. Adv 1000.

PACKER

Automotive parts distributor needs packers. Adv 1000.

SHIPPING MANAGER

Must have experience in all phases of shipping. Adv 1000.

SHIPPING CLERK

Wholesale central distributor needs clerk with USA experience. Adv 1000.

GENERAL MAINTENANCE

Must know air-conditioning, electrical, plumbing, etc. Adv 1000.

TRAILER MECHANIC

Must be able to do PM work. Adv 1000.

Shipping Clerk

Must be good with figures. Adv 1000.

CUTTER

Children wear, sew in section. Adv 1000.

WAREHOUSE MANAGER

Experienced in: Adv 1000.

PACKER

Several positions for packers. Adv 1000.

FOREMAN

For Recap Shop using pre-cast rubber goods. Adv 1000.

SHIPMENT

Inventory Clerk. Adv 1000.

ANILAM

Self starting mechanically inclined person with experience. Adv 1000.

J1-88 Trades

ELECTRICIAN

Experienced in: Adv 1000.

ELECTRICIANS

Unemployed electrician & experienced electrician. Adv 1000.

PRESSPERSON

Mr. Steady, One of the largest printing companies in the South. Adv 1000.

FORKMAN

For this large, progressive company. Adv 1000.

HEAVY DUTY TRUCK MECHANIC

Experienced in: Adv 1000.

EXPERIENCED

Call: Horne Adv 1000.

CAMERA

Experienced in: Adv 1000.

ARTIST

Must be experienced. Adv 1000.

MECHANIC

Experienced in: Adv 1000.

REFRIGERATION & SODA

Experienced in: Adv 1000.

EXPERIENCED

Call: Horne Adv 1000.

GENERAL MAINTENANCE

Experienced in: Adv 1000.

PRINTING

Experienced in: Adv 1000.

CARPENTERS

Experienced in: Adv 1000.

Strippit Operator

Experienced in: Adv 1000.

Forklift Operator

Experienced in: Adv 1000.

HI-LIFT MARINA

Experienced in: Adv 1000.

EXPERIENCED ONLY

Call: Horne Adv 1000.

J1-88 Trades

WINDOW

Experienced in: Adv 1000.

SERVICE REPRESENTATIVE

Medical equipment service. Adv 1000.

Assistant Cutter

For Carves Airlines. Adv 1000.

WANTED

Call: Horne Adv 1000.

Dragline Operator

Experienced in: Adv 1000.

AUTOMATIC DOOR INSTALLER

Must be able to service & install. Adv 1000.

EXPERIENCED

Call: Horne Adv 1000.

LANDSCAPE FOREMAN

Must know landscape. Adv 1000.

LANDSCAPE MAINTENANCE SUPERVISOR

Experienced in: Adv 1000.

VENDING MECHANIC

Experienced in: Adv 1000.

WOMEN TO VENDORS

Experienced in: Adv 1000.

EXPERIENCED

Call: Horne Adv 1000.

PAINTER

Experienced in: Adv 1000.

CAMERA-STRIPPER

Experienced in: Adv 1000.

BODY PERSON

Experienced in: Adv 1000.

FIBERGLASS

Experienced in: Adv 1000.

GENERAL MECHANIC

Experienced in: Adv 1000.

3 DESIGNER DRAFTSPERSON

Structural. Adv 1000.

J1-88 Trades

SHEET METAL LAYOUT

Level for punch areas work. Adv 1000.

AB BACK PRESS OPERATORS

Call: Horne Adv 1000.

PULL

Call: Horne Adv 1000.

COMMERCIAL

Call: Horne Adv 1000.

WELDER

Experienced in: Adv 1000.

CERTIFIED

Call: Horne Adv 1000.

JEWELRY

Manufacturer in N. Miami. Adv 1000.

OVERSEAS EMPLOYMENT

Call: Horne Adv 1000.

MANAGER

Call: Horne Adv 1000.

MECHANIC

Experienced in: Adv 1000.

AUTO TECHNICIAN

Join the fastest growing industry. Adv 1000.

2 Service Advisors

Experienced in: Adv 1000.

BOULTON MOTORS

Call: Horne Adv 1000.

Medium Truck Fleet Mechanics

Experienced in: Adv 1000.

3 DESIGNER DRAFTSPERSON

Structural. Adv 1000.

J1-88 Trades

PROTECTOR

Experienced in: Adv 1000.

REFRIGERATION & ICE

Experienced in: Adv 1000.

ASSISTANT PARTS MANAGER

Call: Horne Adv 1000.

PIPE FITTER

Experienced in: Adv 1000.

Band Saw Operator

With 1 year local experience. Adv 1000.

MECHANIC/BODY PERSON

Experienced in: Adv 1000.

10 Factory Workers

Call: Horne Adv 1000.

LANDSCAPE SUPERINTENDENT

Experienced in: Adv 1000.

JOURNEYMEN

Experienced in: Adv 1000.

AIRCONDITIONING

Service persons & installers. Adv 1000.

AUTO TECHNICIAN

Join the fastest growing industry. Adv 1000.

2 Service Advisors

Experienced in: Adv 1000.

BOULTON MOTORS

Call: Horne Adv 1000.

Medium Truck Fleet Mechanics

Experienced in: Adv 1000.

3 DESIGNER DRAFTSPERSON

Structural. Adv 1000.

A third place to look for a job is at the Florida State Employment Service. The address in Broward is 105 E. Broward Blvd., Ft. Lauderdale, which is across from the bus depot next to the Barnett Bank in Ft. Lauderdale. Here you will be interviewed by a counselor who will help you to find a job. The State Employment Service receives listings, for many jobs in the county and vicinity, and there is no charge for this placement service.

A fourth place to find a job is in the company employment office. For example, let us suppose you are interested in working for Bendix as an assembler. You can look up Bendix in the white pages of the telephone book and call the Personnel Office to see if there are any openings available for assemblers. Sometimes, even though a firm is not hiring at the moment, they will ask you to fill out a job application which they will keep on file for any future openings. Sample applications for practice purposes are enclosed.

Board of County Commissioners
Department of Central Services
Personnel Division
Governor's Club Annex
236 S. E. 1st Avenue
Ft. Lauderdale, Florida 33301
(305) 765-5555



Mailed 8/5/80 DM 7

OFFICE USE ONLY			
Position Title			
Entered Reg.			
Rating	E.P.	V.P.	A.R.
App. No.			

APPLICATION FOR EMPLOYMENT "AN EQUAL OPPORTUNITY EMPLOYER"

INSTRUCTIONS: This application must be filled out accurately and completely. All statements are subject to investigation. Exaggerated, false or misleading statements are cause for rejection. PLEASE PRINT CLEARLY or type all information. If an item does not apply, insert N/A (not applicable). Attach any documents, certificates, commendations, etc. you feel will help in the evaluation.

1. POSITION APPLYING FOR: ELECTRONICS TECHNICIAN I		2. EMPLOYMENT OPPORTUNITY ANNOUNCEMENT NUMBER 1333
3. TODAY'S DATE (Month) (Day) (Year)	4. LOWEST ACCEPTABLE SALARY \$ _____ per year	5. WHEN AVAILABLE

6. NAME		
Last Name	First Name	MI

7. SOCIAL SECURITY NUMBER 	9. CURRENT VALID DRIVER'S LICENSE Number State Expiration Date (Month) (Day) (Year) Classification (Check): _____ Operator's _____ Chauffeur's								
8. HOME TELEPHONE NUMBER <table border="1" style="width: 100%;"> <tr> <td>Area Code</td> <td>Number</td> </tr> <tr> <td> </td> <td> </td> </tr> </table> OTHER TELEPHONE NUMBER <table border="1" style="width: 100%;"> <tr> <td>Area Code</td> <td>Number</td> </tr> <tr> <td> </td> <td> </td> </tr> </table>	Area Code	Number			Area Code	Number			
Area Code	Number								
Area Code	Number								

10. PRESENT ADDRESS		
Street Address		
City	State	Zip Code
How long have you lived at present address? _____ Years _____ Months		

11. PREVIOUS ADDRESS		
Street Address		
City	State	Zip Code
How long did you live at previous address? _____ Years _____ Months		

How Do I Groom For A Job Interview?

This is an area in which there is some leeway. Perhaps you are wondering why an employer cares about how you look. One reason for this is that some employers believe that how a person grooms and dresses for the interview may reflect that person's self-concept and attitude towards the world-of-work. Most jobs have dress codes and an applicant's dress may indicate a lack of knowledge about the expectations of employers and regulations pertaining to workers' dress and behavior. Even if you do not agree with the job requirements, the employer has the right to choose whomever s/he wants among equally qualified applicants. So if you want the job, you should be mindful of the regulations and dress expectations.

The major guideline for grooming is to appear neat and clean. Attention to proper hygiene includes bathing, brushing teeth, washing hair, cleaning and trimming fingernails, and so on. A special note to women: Make-up should be used in moderation to enhance one's appearance.

What Should I Wear To The Interview?

The jobs in the world-of-work are divided into two main categories, based on training/education in a trade or profession: *"Blue Collar Jobs" and **"White Collar positions" The field of electronics provides opportunities for both kinds of preparations.

For men a good rule of thumb is to wear a dress shirt, with the collar open and a pair of slacks when applying for a blue collar job. However, it is a good idea to remember that no one ever lost out on a job for proper dressing.

For a "white collar" interview, a suit and tie with dress shoes should be worn.

For women a blouse and skirt or slacks are appropriate when applying for a "blue collar" job. A suit or a dress should be worn when applying for a "white collar" position.

* A blue collar job is usually one in industry with little customer contact.

**A white collar position usually involves contact with customers of the company for whom you work.

How Do I Benefit From Social Security and Unemployment Insurance?

When you think of Social Security, you probably think of

retirement benefits. Among the benefits of Social Security and Unemployment Insurance are the following:

- 1) To provide unemployment insurance for people who have been laid off from their jobs so they can continue to support themselves and their families.
- 2) To provide income for disabled workers.
- 3) To provide income for dependent children in the event of the death of a working parent.
- 4) To provide retirement income for couples and individuals at the age of 65.

Social Security is an automatic deduction from your pay-check. Currently, approximately 6% of your income is set aside for Social Security. Your employer must match your deductions. Therefore, if you double the Social Security deduction shown on your pay stub, the total is the amount paid to the Social Security Administration based on your income.

You must have a Social Security card to work in the United States. If you do not have one, you must go to the Social Security office and fill out a form similar to the below sample.

The address of the Social Security office nearest you may be obtained from the telephone directory listing under the heading of United States Government.

ID	CN	DO
APPLICATION FOR A SOCIAL SECURITY NUMBER		
See Instructions on Back. Print in Block or Dark Blue Ink or Use Typewriter.		
1	YOUR FULL NAME YOU WILL USE IN WORK OR BUSINESS	
2	YOUR FULL NAME GIVEN YOU AT BIRTH	
3	PLACE OF BIRTH	
4	MOTHER'S FULL NAME AT HER BIRTH (Her maiden name)	
5	FATHER'S FULL NAME (Regardless of whether living or dead)	
6	YOUR DATE OF BIRTH	
7	YOUR PRESENT AGE	
8	YOUR SEX	
9	YOUR COLOR OR RACE	
10	HAVE YOU EVER BEFORE APPLIED FOR OR HAD A SOCIAL SECURITY NUMBER?	
11	YOUR MAILING ADDRESS	
12	TODAY'S DATE	
13	TELEPHONE NUMBER	
NOTICE: Whoever, with intent to falsify his or someone else's true identity, willfully furnishes or causes to be furnished false information in applying for a social security number, is subject to a fine of not more than \$1,000 or imprisonment for up to 1 year, or both. Sign YOUR NAME HERE (Do Not Print)		
TREASURY DEPARTMENT Internal Revenue Service RESCREEN ASSIGN DUP ISSUED Return completed application to nearest SOCIAL SECURITY ADMINISTRATION OFFICE		

Understanding Your Pay Stub

Your paycheck will usually have 2 parts, the section which is your actual paycheck, and your pay stub section which is a summary statement of your deductions.

Below is a Pay-Stub for Bill Adams.

The Jones Electronics Company			
Adams, Bill	511-62-8187	082	
Name	Social Security	Department	
9/2/80	47582	40	
Date	Check Number	Number of hours	
\$6.00/hr.	\$240.00		
rate	Gross		
\$14.40	\$4.80	\$220.80	\$9,360.00
FICA	Tax	Net	Net Pay To Date

Bill Adam's Social Security number is 511-62-8187. The Jones Electronic Company will report Bill's Income to the Federal Government under this number.

Bill is in department 082, Electronics Assembly. The check was issued on September 2, 1980 under check number 47582. The stub shows that Bill worked a total of 40 hours this week at \$6.00 per hour. That comes to \$240.00 (Gross).

Next come the deductions (subtractions from your pay). "FICA" is your social security deduction which currently is about 6% of your gross. Federal tax is \$4.80. Bill lives in Florida, so there is not City or State income tax. Other states do have a State tax of 1% to 6%. Finally, after deductions, Bill's take home or net pay is \$220.80. Bill has earned \$9,360 so far this year. It is important to save this stub for tax purposes.

What Are Employee Benefits?

Benefits are services or extras that your employer supplies in addition to your regular pay. Common types of benefits are

discussed below:

- 1) Group Insurance: Hospitalization insurance provided to employees at little or no cost to them.
- 2) Workers' Compensation: Provides a paycheck and medical compensation for injuries occurring on the job.
- 3) Paid Vacation: Vacation time paid for by your employer at your regular rate of pay (usually one or two weeks).
- 4) Sick Leave: Pay for the day you are sick. Some companies have a limit (such as 12 sick days per year or one day a month cumulative).
- 5) Paid Holidays: Pay for days you are not at work such as national or religious holidays.
- 6) Employee Cafeteria: Food available to employees at a low cost.
- 7) Personal and work counseling -- referrals by counselors in the Personnel Office are included.

Be sure to ask about benefits when being interviewed. If you have several job offers, be sure to compare benefits along with salaries.

SECTION III

ACADEMIC REMEDIATION FOR ELECTRONICS
TRAINING: A VOCATIONAL ACADEMY PERSPECTIVE

Submitted by:

Helene Walczak
Research Assistant

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ACADEMIC REMEDIATION FOR ELECTRONICS TRAINING: A VOCATIONAL ACADEMY PERSPECTIVE

Introductory Statement

Economically disadvantaged students entering vocational training face many obstacles. Among the factors impeding success are prior history of unsuccessful experiences; lack of successful role models; social service needs, such as transportation, child care, personal counseling, medical attention; limited exposure to career choices and the world-of-work; lack of information about interests, abilities, and occupational requirements.

In many cases the student circumvents some or most of these difficulties and attempts to embark on a chosen area of training with a high degree of motivation and enthusiasm. In too many cases, however, the student is told that his or her academic level is not adequate for the chosen training. This student is usually given two options:

- 1) Enter a full-time program of academic remediation
- 2) Enter a different area of training

Sometimes students who choose the first option of academic remediation are challenged and enjoy mastering academic skills. However, many students who choose this option become discouraged and drop out of the program. These students verbalize that the material studied has little relevance to their chosen career, and at times the older students find the atmosphere too juvenile. The students who drop out frequently have a history of academic failure and the academic remediation experience may intensify their feelings of inadequacy.

It is these students, at risk of dropping out, who have captured the special interest of the Vocational Academy. An alternative approach may encourage these discouraged students to remain in programs until maximum benefits are achieved.

Review of Literature

Before making recommendations for the Vocational Academy it may prove helpful to examine the manpower literature concerned with academic upgrading.

Employers and the Comprehensive Employment and Training Act (CETA) administrators frequently stress the importance of academic skills for employability. The literature does not consistently support this point of view.

Buktenica (1972) investigated a program based on the successful Santa Barbara Work Training Program. After systematically analyzing the data, he reached two conclusions:

- 1) There was no evidence that poverty resulted from illiteracy.
- 2) Ability to read did not necessarily raise someone out of poverty.

Other reports have been skeptical of the value of Adult Basic Education (ABE). Roomkin (1971), compared three sample groups to assess the impact of two Adult Basic Education programs in Milwaukee, Wisconsin. He collected employability information on ABE completers, ABE dropouts, and eligible participants who did not enter the program. ABE participants who went on to further training indicated the program gave them excellent preparation for employment. However, after performing a cost benefit analysis and evaluating all the data, the researcher concluded that alternative approaches might be more effective for disadvantaged adults than short-term compensatory education.

Fedstein (1973), compared high school graduates and dropouts attending five California colleges. He found that compared with other students, the non-high school graduates were older and consisted of a higher proportion of males. Academic performance of the two groups did not differ significantly, even when adjusted for many factors such as age, sex, marital status, or major field of study.

Two studies report on attempts to enhance job mobility via academic upgrading. McGrath (1974) discusses a demonstration project in which unskilled and semi-skilled workers were offered opportunities for academic upgrading during periods of layoff. Results were disappointing. McGrath states that the primary target group did not perceive the program as offering sufficient benefits to justify enrolling; also employers did not encourage participation.

A classical model of an employer's participation in a program of upgrading is the Alpha case study presented by Granick (1974). This upgrading program was implemented at a small manufacturing company. Distinctive features of this program were a job-task analysis and development of a diagonal/vertical career ladder tied to on-the-job skills training and off-the-job basic education, including General Equivalency Diploma (GED) courses. Overall the program was successful, however, two interesting observations were made concerning the academic program:

- 1) A majority of employees preferred additional skills training to additional basic education, even when

a combination of the two were offered as an alternative.

- 2) Education beyond basic literacy played an infrequent role in preparing blue collar workers for either employment or upgrading, and there was insufficient evidence that federal support in broad educational activities would materially enhance blue-collar worker mobility.

Northrup and Rowan (1973) offer the most critical view of academic upgrading. They surveyed the Adult Basic Education programs operated by Southern paper industries which had been operational for several years. The purpose of these programs was to increase the potential for promotion of Blacks who were originally employed in unskilled jobs. The objective of these ABE programs was to improve educational qualifications of minority employees and thus prepare them for upgrading. Their findings were:

- 1) The Adult Basic Education programs examined promised more than they could deliver.
- 2) The relation of training to promotion was neither thought out carefully beforehand, nor demonstrated after the programs were in effect.
- 3) Relatively few Black disadvantaged workers completed the courses.
- 4) Those who completed the courses showed little improvement in arithmetic and virtually none in reading.
- 5) There was no relationship between taking the course, improvement in test scores, nor job advancement.
- 6) The packaged courses disregarded the cultural characteristics of the trainees.
- 7) Programmed teaching methods were largely unsuccessful, particularly with adults who lacked literacy. Even more intensive training was of minor additional help.

However, the literature suggests that combined basic education and skills training programs can be successful when used judiciously. One example of a successful remediation program is the Training and Technology (TAT) Program at Oak Ridge, Tenn., which boasts a 90% placement rate. During

orientation the Test of Adult Basic Education (TABE), is administered to each student. This test is used for diagnostic purposes in order to assign each student to the proper level of a multi-level math program. Students needing special remedial work in reading, math or other skills are also identified. The program also offers a General Equivalency Diploma (GED) program but attendance is voluntary.

Field Visits

Information for this section of the report was obtained from (ABE) instructors at two sites of the Broward County School Board, GED instructors at two GED sites, a sampling of four Broward Employment and Training Administration (BETA) counselors, a School Board description of the IMTS system, the supervisor of BETA's intake and assessment unit, and two counselors at Broward Community College (BCC).

The IMTS System

Ideally the Individualized Manpower Training System (IMTS) provides individualized instruction depending on client's needs and interests, vocationally oriented materials, vocational counseling, orientation to the world-of-work, "hands on" experience and individualized assessment. These are lofty goals which are often difficult to implement.

A field visit was conducted at BCC on July 23, 1980, by Dr. Hilda O. Fortune, Research Coordinator and myself, in order to evaluate the manner in which IMTS functions. Conferences were held with Elaine Comes, Laboratory Supervisor, and Harriet Narenjo, IMTS Specialist. They have a cooperative relationship in which the IMTS Center has full use of the laboratory resources.

The Learning Resources Center has a variety of audio-visual aids and appears very well equipped. Students listen to or view tapes at individual stations. The tape library is extensive; tapes are available in numerous subject areas and in several languages. Furthermore, the staff appears flexible and willing to adapt the system to students with special needs. The Center is available to all students at BCC. Some students seek out the Center on their own; many are referred by instructors or the counseling office.

The majority of economically disadvantaged students are referred to the IMTS Center rather than directly to the Learning Center. Upon referral to IMTS, students are immediately given the Test of Adult Basic Education (TABE). The TABE assesses grade levels in reading, math and languages. It is divided into six sections: reading comprehension, vocabulary, math

concepts, math computation, spelling and mechanical expression (grammar). There are different forms of the TABE, graduating from easy to medium, to difficult. The proper testing level is determined by giving the student a location test prior to the actual test. The TABE is normed on an adult economically disadvantaged population, and the grade levels assessed range from the third to the twelfth grade.

Upon completing the TABE, a special answer key enables the examiner to locate specific deficits or areas of strength. For example, the student may need special instruction in capitalization or punctuation. The instructor writes an individual prescription based on the student's performance on the TABE. The prescription pinpoints specific books and materials which the student can master individually and at his or her own pace. The books and material are geared toward specific academic areas measured on the TABE. Much of the material is programmed instruction. A self-test is administered by the student from the materials outlined in the prescription sheet. The student also has the answers and explanations in the answer key. The prescription is aimed at levels which will not be so easy to bore the student, nor so difficult to frustrate one.

The books and materials available appear interesting and easy to follow and use. The topics and format are adult-oriented. The students complete the materials independently; however, if they encounter difficulties, they may receive special instruction and assistance from the IMTS specialists. Most of the prescriptive materials used at the IMTS Center and the Central Campus of BCC are to remediate basic skills. Although they are adult oriented, they are not particularly vocationally oriented. For example, a math computation workbook may include some general work-related problems, but no problems will specifically be oriented toward electronics.

When the student completes all of the assignments in the prescription, the work book is returned to the IMTS specialist. The student is then retested on the TABE and a new prescription is developed. Since students work at their own pace, there is no time-frame limiting them from completing the prescription.

When questioned about job related materials, the IMTS specialist found a wealth of books in the closet that were vocationally oriented. The materials included introductory booklets on over 140 occupations, orientation materials to the world-of-work, and self-assessment inventories and questionnaires. Much of the material was attractive, colorful, skillfully packaged and often geared toward economically disadvantaged individuals. Unfortunately, it appeared inaccessible and inadequately utilized.

The IMTS Center at Central Campus does not contain the work evaluation or work sample stations usually included in an IMTS system. It was explained that due to the expense involved, only the BCC Downtown Campus contains these work stations.

"Work Evaluation" consists of Singer or Tower work samples which provide "hands-on" experience in skills required in a wide array of occupations. The student listens to taped or verbal instructions and follows the directions with the supplies available at each station. For example, at a cosmetology station the student follows instructions on how to shampoo, dye, cut and dry the mannequin's hair.

Work samples are available for many occupations. Among the most popular are the nursing, retail sales, clerical, plumbing, welding and photography work stations. Since the students work at their own pace, as in the academic remediation section of IMTS, they spend as much time as required on each station. Typically, however, it takes approximately two hours to complete each station and two weeks to complete the entire work evaluation.

The work evaluation unit serves several useful functions. It exposes students to the general world-of-work, it gives them better appreciation of their strengths and abilities, it widens their understanding of skills required on various jobs, and exposes them to occupations which they may not have considered in the past. In particular, it may assist in directing women into non-traditional jobs.

Factors Relating to Success

Instructors and counselors working with BETA's program of academic remediation, have difficulty isolating factors related to successful outcome. However, the student's attitudes and apparent level of motivation are often identified as crucial indicators of success in the program.

The student's entry reading level does not directly correlate with degree of progress--with one exception: The teachers interviewed agree that students entering the program with less than a fifth or sixth grade reading level have tremendous difficulty and they progress very slowly. This is the case even when the student's enthusiasm and apparent level of motivation are very high.

The instructors believe the average ABE or GED student referred by BETA finds the traditional school system unrewarding, and alien to his/her past interests and experiences. However, the student who cannot read at all usually has special needs which remain undetected.

The literature suggests that many of these students are dyslexic, i.e., they may have specific perceptual difficulties which interfere with learning to read. These students need special instruction if they hope to learn to read.

The Work Training Program (1972) in Santa Barbara, California sought to improve the education of unemployed heads of poor families. The instructor found that about 30 percent of the participants suffered from developmental dyslexia--they could not be taught to read and write by traditional methods and were often incorrectly considered to be mentally retarded. They were taught to compensate for their disability and learned to read and write through the use of special techniques.

A subsequent three-year follow up indicated a high degree of success in teaching dyslexic students. The greatest gains were seen in the student's self-esteem and social attitudes. The authors point out that mild cases of dyslexia were most responsive to individual instruction.

Recommendations for Vocational Academy

The objectives of the Individualized Manpower Training System can be incorporated into the Vocational Academy model. The relevant goals are:

- 1) To provide basic remedial education specifically related to occupational training.
- 2) To provide for individuals who are educationally deficient or totally illiterate, poorly motivated, or having limited employability skills.
- 3) To help trainees arrive at realistic assessments of their goals, interests, and abilities.
- 4) To equip trainees with basic remedial education, employability skills and general occupational capabilities which are prerequisites for training in an occupational cluster.
- 5) To provide core curriculum training in skills and knowledge which are common to various occupations within a cluster.

The basic methods by which these objectives are implemented can be adapted to the model of the Vocational Academy. Shortly after admission to Level 1 instruction, the TABE would be administered to the student. The student would be informed that this test would be used for diagnostic purposes only and would not be used as a barrier to vocational training.

Students scoring below a fifth grade reading level would have an appointment with an assessment technician to determine if any undiagnosed barriers to learning exist, e.g., need for glasses, audiometric evaluation, specific perceptual difficulties. These tests, as appropriate, would be used as counseling tools--not as barriers to the student's continuing in the program.

The student with at least minimal reading skills would be given individualized instruction, depending on the student's specific deficits and career goals. Where appropriate, the student would also be given the option of entering a self-paced GED program. Depending on the student's needs, remedial instruction can be available via programmed instruction or individual tutoring. Remedial instruction will be available to students on a voluntary basis for at least two hours a day. Whenever possible, the remedial instruction will be oriented to the electronics field.

All remedial instruction will be geared toward the tri-level electronics career ladder described in an earlier paper. (See Figure #1 for representation of this career ladder). Level One in this model includes training for electronics assembler positions. Level Two includes tester or inspector occupations, with specialties in computer or communication equipment. Level three includes electronics technician positions.

Reading - Job-Related

Although many schools set up specified reading levels for admission, it is not mandatory that students be able to read in order to obtain employment as an electronic assembler. Students learn to assemble and solder printed circuit boards according to color codes. Thus for students who do not intend to advance past the electronics assembler stage, remediation in basic skills is unnecessary. However, survival and safety skills could be emphasized, i.e., students should be able to recognize signs such as, danger, exit, poison, etc.

Levels II A and B train students for a variety of different jobs, each of which has its own reading requirements. Some level II A jobs such as inspector positions require minimal reading skills. That is the inspector visually examines manufactured items to insure quality control and rejects any defective parts.

Other Level II A jobs such as tester require more advanced reading ability. The types of reading skills would vary according to the complexity of the manufactured product. The tester should be able to identify the key words found in an electronics glossary. Some testers may also be required

SAMPLE CAREER LADDER

Fig. 1

Career Step I

Job Title: Electronics Assembler

Entry Requirements:

Must not be colorblind,
No formal educational
requirements

Job Description:

- assembles electronic equipment
- bolts components
- connect lead wires to terminals
- solder wires to multiple connectors
- fasten wires and cables

Career Step IIa

Job Title:

Test Technician

Entry Requirements:

- 10th to 12th grade reading level, knowledge of algebra

Job Description:

- compares wiring and assembly details to accepted models to insure conformance
- investigates causes for rejects

makes recommendations for elimination of causes of rejects

Career Step IIb

Job Title:

Computer Bench Worker

Entry Requirements:

- 8th grade reading level

Job Description:

- Tests equipments
- before it leaves factory
- Makes repairs so that finished product is in working order
- investigates source of breakdowns

Career Step III

Job Title:

Junior Electronics Technician

Entry Requirements:

- High School diploma, 12th grade reading level, solid math background

Job Description:

- Assists engineers by wiring and testing engineering models of electronic devices
- uses or supervises the use of engineering equipment and instruments
- analyzes and solves technological problems
- prepares formal reports on experiments and tests
- makes complex parts, components, subassemblies

to understand training manuals, memos, and other forms of written instruction. Students who appear unable or uninterested in advancing in academics could be counselled as to which Level II jobs would be most appropriate.

Students aspiring to Level Three should be encouraged to obtain a GED in order to give them a more well-rounded background. These students must have excellent reading comprehension, good general vocabulary, and should possess fairly rapid reading speed. These students would be given electronics manuals to read and improve upon comprehension skills in the following areas:

I. Literal Understanding

- Recalling Information and Details
- Finding related information
- Identifying words from context
- Recognizing main ideas
- Identifying supporting details
- Following sequence of ideas

II. Interpretation, Analysis, Evaluation

- Predicting Outcomes
- Drawing Conclusions
- Generalizing from Main Ideas
- Paraphrasing
- Finding Key Sentences
- Recognizing Cause and Effect
- Finding Question/Answer Patterns in Paragraphs
- Finding Conclusion/Proof Patterns in Paragraphs
- Recognizing Cause and Effect Statements
- Recognizing Classifications
- Recognizing Comparisons
- Determining Relative Importance of Information

III. Study Skills

- Scanning and Skimming Materials
- Relating Pictures to Text
- Understanding Headings
- Reading Diagrams
- Reading Graphs
- Reading Maps and Charts

Arithmetic

As mentioned in the Reading section, the basic skills required for Level I electronic assemblers are minimal. The student should be able to identify whole numbers and fractions, make change, and perform simple addition, subtraction, multiplication, and division problems, e.g., the student should be able to compute the expected amount of his/her paycheck and understand the required deductions.

Since Level II jobs are varied they require varying levels of arithmetic ability. Some jobs, such as the Inspector do not require more than basic computational skills. Other jobs, such as Tester, may require knowledge of algebra and decimals. Level II Arithmetic Skills include:

I. Decimals

- A. Reading and writing decimals
- B. Addition, subtraction, multiplication, and division of decimals
- C. Degree of accuracy in measurement and rounding off
- D. Converting to fractions and percentages

II. Ratios and Proportions With Practical Electronic Conversion Problems

III. Units of Measurement

- A. Use of rulers and tapes
- B. Metric System
- C. Electrical measures
 - 1. amps
 - 2. volts
 - 3. ohms
 - 4. watts

IV. Introduction to Boolean Algebra

The bulk of math theory will be found at Level III. Level II would involve learning simple formulas by rote. Level III would require understanding rationale for the formula.

Level III Skills involved would include:

I. Basic Algebra and Solving Equations

- A. Algebraic signs and functions
- B. Changing signs
- C. Consolidation and elimination
- D. Parentheses
- E. Ohm's Law Formulas

II. Geometry

- A. Measuring area of rectangle, square, triangle, parallelogram, circle
- B. Measuring circumference of above

III. Trigonometry

- A. Parts of right triangle
- B. Pythagorean Theory

V. Vector Analysis

- A. Capacitance
- B. Inductance
- C. Resistance
- D. Impedance

VI. Logarithms and Square Roots

- A. Raising numbers to given power
- B. Extracting square roots
- C. Computation with Logarithms
- D. Mantissa
- E. Reading log tables

VII. Reading Graphs and Specifications

Math Anxiety

The issue of math anxiety has received a great deal of attention recently. It is a particularly germane issue for electronics training since the majority of CETA enrollees in skills training are female and the literature documents female underachievement in mathematics and female math avoidance.

In order for women to realistically aspire to Levels II or III in Electronics, they must somehow gain the confidence necessary to tackle higher level math concepts. Tobias and Weissrod (1980) suggest a behavior therapy approach to deal with self-defeating math attitudes. Several techniques are mentioned as possibilities:

- 1) Providing information on specific coping techniques and providing successful role models.
- 2) Counselling students to help them overcome their fear of success and break habits and expectation of failure.

- 3) Changing the classroom atmosphere from one of tension to one of trust and relaxation.
- 4) Learning how to learn math--that is replacing debilitating habits with self-instruction and encouragement.
- 5) Recognizing how anxiety impedes learning and increases ability to take credit for success.
- 6) Providing positive math experiences through group and instructor encouragement.

However, Tobias and Weissrod (1980) point out that none of these techniques has been experimentally proven successful. For the purposes of the Vocational Academy, a combination of the above techniques might prove most successful.

Writing - Job-Related

Writing for the purpose of this report refers to effectively communicating thoughts through language on paper. This is still positively correlated with reading ability. However, deficiencies sometimes occur in particular mechanical areas such as spelling, capitalization, grammar, punctuation, sentence structure, etc. The IMTS system is particularly suited to remediate these deficiencies.

At Level I electronics assembler positions, the need for writing skills is minimal. If the student is able to fill out a job application appropriately, remediation at this level is not indicated.

Level II includes a variety of inspector and tester jobs most of which require minimal writing skills. The degree of expertise in language will vary greatly from company to company. However, the student exiting at this level should at least be able to compose an effective job resume.

Unquestionably, the greatest need for adequate writing skills occurs at Level III. The technician's job description frequently includes writing formal reports on experiments and tests. Most schools offering an electronics technician degree or certificate acknowledge this need. Broward Community College, Nova University, and the South Florida Technical Institute all offer training in technical writing or communication skills as part of their curricula. There is a large gap between Level II and Level III required language skills.

Skills necessary at this level run the gamut, including fundamentals of English composition, basic writing techniques,

methods for logical organization of ideas, formats for technical reports, technical vocabulary, as well as fundamentals of grammar, spelling, punctuation, sentence construction, etc.

Many of these skills can be combined with the coursework in the curriculum. For example, after demonstrating an experiment illustrating Ohm's law, students should be able to write a brief technical report.

In view of the large gap between Levels I, II and III in communication skills, it would be wise to start training students early in these skills. If a student expresses an interest in progressing to the technician level, writing and language remediation should be instituted immediately. For students who do not aspire to this level, writing skills do not need to be emphasized.

Summary

A review of the literature, as well as field reports, reveals that traditional academic remediation methods are often ineffective. Even when academic progress is made, concomitant progress in employability or starting wage is frequently not evident.

The IMTS system attempts to bypass the usual pitfalls by individualizing the program and stressing job-related academic skills. However, as we have seen, in practice the IMTS does not always fulfill these fine ideals.

The Vocational Academy could adapt the IMTS system to a career ladder electronics training program. Students would have the option of receiving individual academic instruction at Levels I and II. Students who wish to work on a high school diploma will be supplied with the necessary GED materials in order to work at their own pace.

At Levels I and II academic instruction will consistently relate to electronics curriculum in order to sustain the students' interest. "Shop talk" and an atmosphere similar to working conditions will be stressed as much as possible. At Level III, a state of abstraction is required which encompasses more than strictly job-related material.

Some of the features which make the Vocational Academy approach unique include:

- 1) Utilization of behavior modification techniques to reduce math anxiety
- 2) Sensitivity to special problems which constitute barriers to learning. Screening for perceptual

difficulties can be used when appropriate.

- 3) Voluntary attendance in academic remediation to enhance interest and motivation.
- 4) Ongoing inservice training for staff to insure continued high quality instruction.
- 5) Use of job related materials geared specifically towards electronics and its career ladders.

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SECTION IV

PERFORMANCE ASSESSMENT
OF ELECTRONICS TRAINEES

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Performance Assessment

Evaluation Procedures

In any educational endeavor, the subject of assessment will appear as one of the major problems to be addressed. While teachers wonder how they will assess their students, the students are wondering on what and how they will be tested.

This paper will examine two specific kinds of testing that are most relevant to our population: teacher constructed paper and pencil tests and judging procedures, products and performance. However, before looking at these in detail, let us review the different kinds of tests available.

Lein (1976) lists five basic types of evaluation procedures, which are:

- 1) Standardized ability and aptitude tests. These include intelligence tests, such as the Stanford-Binet and the Wechsler Adult Intelligence Scale.
- 2) Standardized achievement tests. Examples of this type of test include the Scholastic Aptitude Test, American College Test and the Graduate Record Examinations.
- 3) Teacher constructed paper and pencil tests. As the name implies, these tests are written by the teacher for use within his or her class only. These tests can be objective, multiple choice, matching or essay.
- 4) Judging Procedures, products and performance. These evaluation techniques include evaluation of students' procedures without regard to the product, evaluation of the product without regard to the procedures, or evaluating both procedures and products. A typical science fair exhibit is evaluated by this technique.
- 5) Observation tools, which is a show and tell type examination. An example of this type of examination occurs after a class has made a field visit and is asked questions about that visit.

As was mentioned previously, this paper will focus on paper and pencil and judging procedures only. Nunnally (1978) discusses the construction of achievement tests. He uses the achievement test broadly to include examinations of individuals in specific courses.

According to Nunnally, the first rule in preparing a test is to begin with a test plan. This test plan should include: 1) an outline of the content which will be covered on the examination; 2) a description of the types of questions, i.e., multiple choice, true/false, essay that will be use on the examination; 3) the number of test questions; 4) an example of the type of questions to be used; 5) administrative procedures such as how the instrument will be administered, how long it should take to administer, and scoring procedures.

Wesman (1971) states that test questions often have two basic flaws: first, they are often ambiguous; and secondly, the items often cover trivial aspects of the subject matter. The following is an example of a too ambiguous statement: "whathappened to electronics after World War II?"

Nunnally (1978) prefers multiple choice questions because they tend to be less ambiguous. In addition, Nunnally says that a good multiple choice test correlates highly with an essay test on the same material. Nunnally also prefers multiple choice tests because the subject area can be sampled more broadly in a multiple choice format.

Among the problems with teacher construced Paper and Pencil tests is reliability. That is, if given again, or if an alternative form of the test is given, a similar score or range of scores should be achieved.

Another issue is validity: Does the test measure what it is supposed to measure? For example, is the trainee able to properly apply acquired knowledge. Here is where Paper and Pencil tests often fail - a teacher deciding to select 50 items for an examination may be forced to choose some trivial questions in order to achieve the desired 50 item test.

To summarize, Nunnally stresses content validity, that is, a test must measure what it is supposed to measure. It takes some skill to write items that conform to the domain of knowledge that has been specified, and for this reason content validity is often only partially achieved. One final drawback to the use of teacher constructed paper and pencil tests are that they assume the examinee has a good reading ability. This is often not the case in the vocational school setting and for this reason these tests should not be used if a better alternative exists.

The focus population of the Vocational Academy is the CETA participant under Title II B which is an economically disadvantaged, unemployed person. The mean reading and comprehension level for these participants is at the 6th grade level. Therefore, given a high dependency on one's ability to read, the paper and pencil and multiple-choice tests seem less valuable in a vocational setting.

Fitzpatrick and Morrison (1971) discuss the use of performance and product evaluation. They begin by criticizing traditional assessment because of its lack of applicability. They state that it makes poor economic sense to sacrifice applicability for efficiency.

The authors go on to discuss the simulation of an on-the-job setting necessary for the use of performance and product evaluation. They further state that the closer the fidelity between the simulated and the "actual" environment, the better the validity of the test will be.

Fitzpatrick and Morrison offer four guidelines for better simulation. Paraphrased these are:

- 1) Decide which critical aspects of the actual job environment will be simulated.
- 2) Decide how much fidelity is needed for a good simulation, then decide the worth of increasing fidelity even more. For example, let us suppose that we have simulated an electronics company setting. We have set up individual work areas, we have relevant machines, we have even included a time clock and check-in procedures.

We must then ask, "have we left anything out that is relevant?" if the answer to this is no, our next question would be "what would be the effect of over-simulation, would it enhance our results in any substantial way?"
- 3) Keep in mind the physical resources you have available -- space, money, etc.
- 4) Balance fidelity and comprehensiveness as needed, keeping in mind the minimum amount of fidelity required.

While there are many types of performance and product evaluations, the one which is most applicable to the Vocational Academy is the work-sample test. In this type of test, someone acting in the capacity of the "supervisor" asks the examinee to perform a job-related task and either the product, the performance or both are assessed. According to Fitzpatrick and Morrison (1971), this technique has high validity in that the task the examinee is asked to perform is a job-related one. Other advantages of this type of evaluation are that many people can be examined on the same task in a relatively short period of time. For those examinees with a reading problem, this type of evaluation is especially appropriate because there is little or no reading involved in the examination.

Baldwin (1971) suggests that a rating system used in conjunction with a work sample test allows the instructor to give specific feedback regarding what the student did very well and what was done poorly.

He goes on to state that because a rating scale can be very explicit, high reliability often results. However, in order to ensure good reliability, one should occasionally use two independent raters.

During these reliability checks, the inter-rater reliability (correlation) should fall between .80 and .90. A scale for evaluating a soldering job would look something like this:

Soldering the Iron

1	2	3	4	5
Puts too little tin on the iron.	Puts a little less than should be on the iron.	Puts too much tin on the iron.	Approaches the correct amount of tin on the iron but still uses a bit too much.	Puts the right amount of tin on the iron.

With performance assessment guidelines, the student receives very specific feedback; and for this reason, it is less likely that the problem will be repeated at the next assessment.

Summary

This paper has examined two types of educational measurement: traditional educational measurement (paper and pencil) and performance and product evaluation. It was shown that traditional paper and pencil tests often have problems with low reliability and validity. In addition these tests often do not measure the ability to apply what has been learned.

On the other hand, performance and product evaluations do not have the problems with reliability and validity because they attempt to simulate the job-related activities that the examinees are being trained to perform. In addition, there is no reading nor any writing involved in this type of evaluation; and for this reason, these tests are especially useful for trainees with low reading and comprehension levels.

Considering all the benefits of the performance and product evaluation, the de-emphasis on reading skills, the high reliability and validity, and the ability to provide accurate and specific feedback to students, it is recommended that the Vocational Academy use performance and product evaluations in order to assess its students.

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